TWENTY-SECOND ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE.

1906.

STATE OF MAINE.
1907.

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

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Lucius H. Merrill	
Fremont L. Russell	
Welton M. Munson	
Gilbert M. Gowell	
Edith M. Patch	
Warner J. Morse	

THE STATION STAFF.

Charles D. Woods	*Director*
James M. Bartlett	*Chemists*
Lucius H. Merrill	
Herman H. Hanson	
†Lewis I. Nurenberg	
*Arthur C. Whittier	
‡Joanna C. Colcord	
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Pomologist*
Gilbert M. Gowell	*Poultry Investigations*
Walter Anderson	
Edith M. Patch	*Entomologist*
*Warner J. Morse	*Vegetable Pathologist*
*Royden L. Hammond	*Seed Analyst and Photographer*
Annie M. Snow	*Clerk and Stenographer to the Director*
‡Blanche F. Pooler	*Stenographer*
Henry A. Millett	*Meteorological Observer and Janitor*

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* Appointed July 1, 1906.
† Resigned July 1, 1906.
‡ Appointed Sept. 1, 1906.

TABLE OF CONTENTS.

The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

ANNOUNCEMENTS.

THE AIM OF THE STATION.

Every citizen of Maine concerned in agriculture has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glassware; to identify grasses, weeds, injurious fungi and insects, etc.; and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

INSPECTIONS.

The execution of the laws regulating the sale of food, commercial fertilizers, concentrated commercial feeding stuffs, and agricultural seeds, and the inspection of chemical glassware used by creameries is entrusted to the Director of the Station. The Station takes pains to obtain for analysis samples of all brands of fertilizers and feeding stuffs coming under the law. It also draws samples of agricultural seeds and foods in the hands of dealers. The co-operation of dealers and consumers is, however, essential for the full and timely protection of their interests.

Foods. Dealers and consumers are invited to send by prepaid express original and unbroken packages of food materials on sale in Maine of whose purity they are for any reasons sus-

picious. As prompt free analysis will be made of such samples as circumstances will allow.

Feeding Stuffs. The Station will promptly analyze samples of feeding stuffs sold in Maine taken in accordance with directions which will be furnished on application. The results will be reported without charge to interested parties. This applies to dealers and consumers alike.

Commercial Fertilizers. It is difficult to draw accurate samples of commercial fertilizers. On this account it is only in rare instances that the Station undertakes analyses of fertilizers other than the samples collected by its representatives. In case there is special reason for an examination, the Station invites correspondence on the subject.

Agricultural Seeds. Samples of agricultural seeds on sale in Maine, taken in accordance with directions which can be obtained on application to the Station, will be examined as promptly as possible and the results reported free of charge.

In all cases samples should be accompanied by a full description of the goods, including the name and address of the dealer and the sender. Small samples other than liquids can be forwarded by mail. Others should be forwarded by express, charges prepaid.

STATION PUBLICATIONS.

The station publishes several bulletins each year, covering in detail its expenses, operations, investigations and results. The bulletins are mailed free to all citizens who request them. The annual report is made up of the bulletins issued during the year.

CORRESPONDENCE.

As far as practicable, letters are answered the day they are received. Letters sent to individual officers are liable to remain unanswered, in case the officer addressed is absent. All communications should, therefore, be addressed to the

Agricultural Experiment Station,

Orono, Maine.

The post-office, railroad station, freight, express and telegraph address is Orono, Maine. Visitors to the Station can take the electric cars at Bangor and Old Town.

The Station is connected by telephone.

HISTORICAL NOTES FOR 1906.

THE ADAMS ACT.

The Adams Act, which provides ultimately for the increased endowment of all the Hatch Experiment Stations by $15,000 per annum, was approved by the President March 16, 1906. The amount available for the fiscal year 1905-6 was $5000. The amount for the current fiscal year is $7000. This fund can be used only for "original investigations and experiments" and is not available for the general maintenance of the Experiment Station.

At the April meeting of the Experiment Station Council, it was decided to devote the Adams fund for the present to the following lines of work,—studies upon the nutrition of man; investigations of orchard problems; a study of plant diseases; and problems in breeding.

CHANGES IN STAFF.

As a result of the Adams Act, it became possible to change the appoinments of certain Station officers that have had part College and part Station work, so that their whole time can be given to Experiment Station work.

Mr. L. H. Merrill, formerly chemist to the Station and Professor of Biological Chemsitry in the University, now devotes his whole time to the Nutrition Investigations.

Dr. W. M. Munson, formerly Professor of Horticulture in the College of Agriculture, and Horticulturist to the Experiment Station, has been appointed Pomologist to the Station and now devotes his whole time to investigations relating to the orchard interests of the State.

Mr. W. J. Morse, B. S., University of Vermont, 1898, assistant in botany at the Vermont Experiment Station since 1901, has been appointed Vegetable Pathologist and assumed his duties July 1. His work is the study of the plant diseases of Maine.

Mr. L. I. Nurenburg resigned his position as assistant chemist in the Nurtition Investigations and Miss J. C. Colcord, B. S., in Chemistry, University of Maine 1906, has been appointed his successor.

Mr. A. C. Whitney, B. S. in Chemistry, University of Maine, 1905, was appointed July 1, assistant chemist in the inspection work.

January 1, Miss B. G. Leeds resigned her position as Photographer and Seed Analyst in the Station, and Mr. Roydon L. Hammond has been appointed her successor.

HOLMES HALL.

As described in the annual report for 1905, a north wing was added to Holmes Hall for the use of the College of Agriculture. With the increased appropriation, the Experiment Station needed added room, and the University has turned this wing over for the permanent use of the Station.

The west room on the first floor of the north wing will be used for the work in breeding. The east room on that floor is used by the Vegetable Pathologist. A laboratory and incubator room for the Vegetable Pathologist has been fitted up in the northeast corner of the basement.

The west room on the second floor is being used by the Entomologist and as a nucleus of a museum; and the east room on the second floor is occupied by the Pomologist. The former office of the Professor of Agriculture has been added to the general offices of the Experiment Station.

The former office of the chemist has been changed into a nitrogen laboratory, and the office of the veterinarian is being changed into a chemical laboratory. A hallway has been built across the rear of the former nitrogen laboratory and the west room in the wing so that the north and west entrances are now connected by hallway.

SEED INSPECTION.

Chas. D. Woods, Director.

Bessie G. Tower, Analyst.

In order that the farmer might be able to find out, if he so desired, what quality of seed he was buying, a law was passed in Maine in the winter of 1897, regulating the sale of agricultural seeds, and providing for the testing of samples of seeds, either by the Maine Agricultural Experiment Station, or in accordance with directions prescribed by the Director of the Station.

This law was satisfactory as far as it went, and resulted in an improvement in the character of the seed sold in the State. It did not provide for an inspection and as time has passed the moral effect of the law has to some extent and with some dealers grown less. To remedy this, the Legislature of 1905 passed an additional section to the law, calling for an inspection somewhat similar in requirements to that of the laws regulating the sale of commercial fertilizers, foods and feeding stuffs. The chief requirements of the law and the full text of the law follow:

CHIEF REQUIREMENTS OF THE LAW.

Kind of Seeds Coming Under the Law. The law applies to every lot of seeds, containing one pound or more, of cereals, grasses, forage plants, vegetable and garden plants, but does not apply to sweet corn, trees, shrubs and ornamental plants.

The Guarantee. Every lot sold, offered or exposed for sale must be accompanied by a written or printed guarantee of the percentage of purity.

TEXT OF THE LAWS.

Chapter 39, Revised Statutes.

Regulation of Sale of Agricultural Seeds.

Sec. 27. Every lot of seeds of agricultural plants, whether in bulk or in package, containing one pound or more, and

including the seeds of cereals, except sweet corn, grasses, forage plants, vegetables and garden plants but not including those of trees, shrubs and ornamental plants, which is sold, offered or exposed for sale for seed by any person in the state shall be accompanied by a written or printed guaranty of its percentage of purity and freedom from foreign matter; *provided,* that mixtures may be sold as such when the percentages of the various constituents are stated.

SEC. 28. Dealers may base their guarantees upon tests conducted by themselves, their agents or by the director of the Maine Agricultural Experiment Station; *provided,* that such tests shall be made under such conditions as the said director may prescribe.

SEC. 29. The results of all tests of seeds made by said director shall be published by him in the bulletins or reports of the experiment station, together with the names of the persons from whom the samples of seeds were obtained. The said director shall also publish equitable standards of purity, together with such other information concerning agricultural seeds as may be of public benefit.

*SEC. 30. Whoever sells, offers or exposes for sale or for distribution, in the state, any agricultural seeds without complying with the requirements of sections twenty-seven and twenty-eight, or whoever, with intention to deceive, wrongly marks or labels any package or bag containing garden or vegetable seeds or any other agricultural seeds, not including those of trees, shrubs and ornamental plants, shall be punished by a fine not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

SEC. 31. The provisions of the four preceding sections shall not apply to any person growing or selling cereals and other seeds for food.

*SEC. 33. Whenever the said director becomes cognizant of any violation of the preceding sections, he shall report such violation to the commissioner of agriculture, and said commissioner shall prosecute the party or parties thus reported.

The matter not relevant to seeds is omitted.

Chapter 66 of the Laws of 1905.

An Act to Further Regulate the Analysis of Food and Agricultural Seeds.

Sec. 1. The director of the Maine Agricultural Experiment Station shall analyze, or cause to be analyzed, samples of agricultural seeds sold or offered for sale under the provisions of chapter thirty-nine of the revised statutes. He shall take in person or by deputy, a sample, not exceeding four ounces in weight, for said analysis, from any lot or package of agricultural seeds which may be in the possession of any grower, importer, agent or dealer in the state.

Sec. 2. There shall be appropriated annually from the state treasury the sum of one thousand dollars in favor of the Maine Agricultural Experiment Station, and the same may be expended in the analysis of food and agricultural seeds. So much of said appropriation shall be paid by the treasurer of state to the treasurer of said Experiment Station as the director of said station may show by his bills has been expended in performing the duties required by the acts regulating the sale and analysis of food and the sale of agricultural seeds. Such payment shall be made quarterly upon the order of the governor and council, who shall draw a warrant for that purpose.

Sec. 3. This act shall take effect when approved.

[Approved March 15, 1905.]

TESTING SEEDS AT HOME.

It is important to the user of seeds not only to know their percentage of purity and what kind of weeds they carry, but to also know something of their vitality. In the case of seeds there are at least three ways whereby the user may be injured. A seed which carries foreign matter of any kind, in any considerable amount, is correspondingly lowered in value. But there is another reason which is more important than the money consideration, and that is that the weed seeds which the seeds contain may be pernicious. For example,—clover seed carries frequently plantain seed. If this plantain seed is the door-yard

variety which is present practically all over Maine, there would be comparatively little harm from using clover seed which contained it. On the other hand—lance leaved plantain or rib grass is not abundant in Maine. It is an undesirable plant and using seed carrying it might introduce a weed into land which is at present free from it. It is important that the farmer should know the vitality as well as the purity of the seed that he is to use. No matter how pure a seed may be, if half of it will not sprout it has no more value than if the seed were half chaff.

While it is not easy to make an exact purity test, it is not difficult for a farmer to so acquaint himself with the seeds that he is ordinarily using that by the help of an ordinary reading or magnifying glass he will be able to tell whether the seed in question contains any considerable amount of impurities. If the seed is spread out upon a white plate, a little practice will enable a farmer to see whether a given seed is reasonably pure or not, and he will soon learn to detect the more common foreign seeds.

It is much easier for the farmer to test the vitality of seed than to make a purity examination. The following simple instructions for performing germination tests at home without any special apparatus will enable the farmer to learn for himself whether the seed that he is using has good vitality or not. Germination tests may be made in two ways,—the so-called blotting paper method, and the sand method. In making the germination test with blotting paper, blue blotting paper of common weight, cut into strips about 6 x 19 inches, should be used. This is laid folded twice so as to get a piece of three thicknesses and about six inches square, on an ordinary dinner plate or platter. The seeds if small are placed on the top of the paper and if large between the folds. The paper is kept moist (not soaked) and at a temperature of 70 to 80 degrees F.

If only a vitality test is desired the blotting paper method is preferable, but if it is desired to know how many seeds may be expected to grow, the sand method is in some ways preferable. In this method a thin layer of fine sand is sprinkled on the bottom of a flat dish and the seeds to be tested placed on it under a thin covering of sand. This must be kept moist and well shaded and at a somewhat higher temperature than in the first case.

At the end of every second day in the case of some seeds, and the third day in the case of those germinating more slowly, the sprouted seeds should be removed from the blotters or the sand and counted, the per cent being readily found by referring back to the number of seeds which were taken for the test. If 100 seeds are used, the number that sprout give the vitality per cent.

DESCRIPTION OF TABLES.

In the present bulletin there are reported the results of purity tests made by the Experiment Station since 1902. Prior to the legislation of 1905, there were no funds for such inspection and only such samples were examined as were submitted by correspondents.

The table on page 6 contains a list of the weeds obtained from seeds here reported upon. They are arranged alphabetically in accordance with the English name. As the common name differs in different parts of the country, the scientific name is given for the purpose of identification.

The table on page 7 summarizes the results of examination of samples of seeds collected by the Station in the spring of 1905; while the table on page 8 summarizes the results of the examination of seeds sent in to the Station by correspondents in the years 1902 to 1905.

In the tables on pages 9 to 16 there are given in detail the results of the analyses of the samples collected by the Station in the spring of 1905.

The tables on pages 16 to 24 contain the analyses of samples sent to the Station by correspondents. In many instances these samples were sent by the dealers themselves and are goods that were offered to them, and it does not necessarily mean that they offered for sale in Maine seeds of this quality. In some instances it is certain that when the examination showed the seeds to be of low purity, they were not brought into the State.

A list of weeds from seeds here reported upon.

Common Name.	Scientific Name.
Awned plantain.	*Plantago aristata.*
Blue vervain.	*Verbena hastata.*
Black mustard.	*Brassica nigra.*
Bitter dock.	*Rumex obtusifolius.*
Buckwheat.	*Fagopyrum fagopyrum.*
Catchfly.	*Silene.*
Careless weed.	*Amaranthus hybridus.*
Clustered dock.	*Rumex conglomeratus.*
Crab grass.	*Syntherisma sp.*
Crane's bill.	*Geranium maculatum.*
Creeping bent.	*Agrostis alba.*
Curled dock.	*Rumex crispus.*
Dooryard plantain.	*Plantago major.*
Evening primrose.	*Oenothera biennis.*
False flax.	*Camelina sativa.*
Five-finger.	*Potentilla monspeliensis.*
Goosefoot.	*Chenopodium album.*
Green foxtail.	*Chaetochloa viridis.*
Gum plant.	*Grindelia squarrosa.*
Lady's thumb.	*Polygonum persicaria.*
Large crab grass.	*Syntherisma sanguinalis.*
Large spurge.	*Euphorbia nutans,*
Mayweed.	*Anthemis cotula.*
Medic.	*Medicago sp.*
Nerved manna-grass.	*Panicularia nervata.*
Nettle-leaved goosefoot.	*Chenopodium murale.*
Night-flowering catchfly.	*Silene noctiflora.*
Orache.	*Atriplex sp.*
Oxeye daisy.	*Chrysanthemum leucanthemum.*
Pennsylvania persicaria.	*Persicaria pennsylvanica.*
Penny cress.	*Thlaspi arvense.*
Pigweed.	*Amaranthus sp.*
Purslane	*Portulaca oleracea.*
Prostrate pigweed.	*Amaranthus blitoides.*
Ragweed.	*Ambrosia artemisiaefolia.*
Ribgrass.	*Plantago lanceolata.*
Rugel's plantain.	*Plantago Rugelii.*
Sheep sorrel.	*Rumex acetosella.*
Slender fescue.	*Festuca octoflora.*
Small crab-grass.	*Syntherisma linearis.*
Sorrel.	*Rumex acetosa.*
Stink-grass.	*Setaria sp.*
Summer savory.	*Origanum vulgare.*
Tall dock.	*Rumex altissimus.*
Tumbleweed.	*Amaranthus graecizans.*
Valerian.	*Valeriana sp.*
White dock.	*Rumex salicifolius.*
White vervain.	*Verbena urticifolia.*
Wild carrot.	*Daucus carota.*
Wild peppergrass.	*Lepidium virginicum.*
Wild turnip.	*Brassica campestris.*
Wormseed mustard.	*Erysimum cheiranthoides.*
Witch grass.	*Panicum capillare.*
Yellow daisy.	*Rudbeckia hirta.*

Tables showing results of Examination of Samples of Seed collected by the Station in 1905.

Names of weeds.	Kind of Seeds and Number of Samples.										
	Red clover.	White clover.	Crimson clover.	Alsike.	Alfalfa.	Timothy.	Red top.	Hungarian.	Siberian millet.	Orchard grass.	Blue grass.
Number of Samples Examined.	25	3	1	16	1	30	15	5	1	1	1
Large crab grass	....	....	....	....	....	....	....	4	....	....	....
Small crab grass	4	....	...	1	....	....	....	....	....	....	...
Witch grass	7	....	....	1	....	1	....	3	....	....	....
Nerved manna grass	....	....	....	2	....	....	....	....	....	....	....
Stink grass	1	....	....	....	....	....	....	....	....	....	....
Green foxtail	13	....	....	....	....	....	....	1	1	....	....
Yellow foxtail	11	....	....	1	1	3	....	1	1	....	...
Lady's thumb	10	....	....	1	....	5	2	5	....	....	1
Clustered dock	2	....	....	....	....	....	....	....	....	....	....
Curled dock	3	....	....	....	....	....	....	....	1	....	....
White dock	....	1	....	....	....	....	....	....	....	....	....
Sheep sorrel	8	2	1	15	....	13	3	....	....	....	1
Sorrel	10	....	....	....	....	1	....	1	....	1	....
Pennsylvania persicaria	....	....	....	....	....	....	....	1	....	....	....
Goose foot	8	2	....	1	....	4	....	2	....	....	....
Winged pigweed	....	....	....	1	1	11	....	5	1	....	....
Pigweed	....	....	...	....	....	....	....	1	....	....	....
Tumbleweed	....	....	...	....	....	1	....	....	1	....	....
Catchfly	....	....	....	1	....	....	....	....	....	....	...
Night-flowering catchfly	....	1	1	2	....	2	....	....	...	....	....
Wormseed mustard	2	....	....	....	....	....	....	....	....	....	....
False flax	....	....	....	1	....	....	...	....	....	....	....
Wild turnip	3	....	1	...	....	....	....	....	....	....	....
Wild peppergrass	2	1	....	1	....	9	3	1	....	....	....
Black mustard	....	....	...	....	....	1	....	....	....	....	....
Penny cress	...	....	....	....	....	1	....	....	....	....	....
Five-finger	....	1	....	1	....	7	10	....	....	....	....
Crane's bill	....	....	1	....	....	....	....	....	....	....	....
Large spurge	....	....	....	....	....	2	...	....	....	....	....
Evening primrose	....	....	....	....	....	1	....	....	....	....	...
Blue vervain	....	....	....	....	....	12	2	....	....	....	....
White vervain	....	....	....	...	....	10	1	....	....	....	....
Awned plantain	3	....	....	....	....	....	....	....	....	...	....
Dooryard plantain	8	3	....	3	....	13	13	....	....	....	....
Ribgrass	11	....	1	1	1	1	....	....	1	....	....
Rugel's plantain	7	2	....	....	....	4	....	....	...	....	....
Valerian	1	....	....	....	....	....	....	....	....	....	....
Ragweed	....	....	....	....	....	8	1	....	....	....	...
Oxeye daisy	...	....	....	....	....	1	....	....	....	....	....
Yellow daisy	....	....	....	....	....	10	1	....	....	....	....
Gumweed	...	....	....	1	....	....	....	3	....	....	....
Mayweed	2	2	....	....	....	3	....	....	....	....	....

Table showing the results of examination of seeds sent in to the Station in years 1902-5.

Names of Weeds.	Kinds of Seeds and Number of Samples.						
	Red clover.	White clover.	Mammoth clover.	Alsike.	Timothy.	Red top.	Crab grass.
NUMBER OF SAMPLES EXAMINED.	21	1	2	20	47	11	1
Creeping bent	......	......	......	......	......	1	....
Slender fescue	......	......	......	......	......	1	....
Green foxtail	18	......	1	2	5	......	1
Yellow foxtail	......	......	1	......	......	......	....
Bitter dock	2	......	......	1	......	......	....
Tall dock	1	......	......	......	......	......	....
White dock	3	1	1	1	......	......	....
Lady's thumb	4	......	......	......	1	......	....
Sheep sorrel	5	1	1	9	13	3	1
Sorrel	1	1	......	6	4	......	....
Buckwheat	1	......	......	2	......	......	....
Orache	1	......	......	......	......	......	....
Goosefoot	4	......	......	......	8	......	1
Nettle leaved goosefoot	......	......	......	1	......	......	....
Careless weed	1	......	......	2	9	......	1
Tumble weed	1	1	1	1	1	1	1
Pigweed	1	......	......	1	......	3	....
Purslane	......	......	......	1	......	......	....
Wild peppergrass	1	......	......	6	22	7	1
Night-flowering catchfly	......	......	......	1	......	......	....
Medic	......	......	......	1	......	......	....
Wild carrot	......	......	......	......	1	......	....
White vervain	......	......	......	......	1	......	....
Summer savory	......	......	......	......	1	......	....
Dooryard plantain	1	1	......	......	5	......	....
Rugel's plantain	......	......	......	1	6	......	....
Awned plantain	1	......	......	......	......	......	....
Ribgrass	6	......	......	2	......	......	....
Ragweed	1	......	......	......	......	......	....
Oxeye daisy	......	......	......	......	4	1	....
Yellow daisy	......	......	......	......	13	......	....

Analysis of seeds. Samples collected by the Station in the spring of 1905.

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	RED CLOVER. (*Trifolium pratense.*)	Per ct.	Per ct.	Per ct.
418	From C. M. Conant Co., Bangor, May 5, 1905. *Number of foreign seeds in 1 pound.* Timothy, 200; lady's thumb, 100; clustered dock, 200; goosefoot, 200; dooryard plantain, 400; embryos, 100.	99.5	0.1	0.4
416	From C. M. Conant Co., Bangor, May 5, 1905. *Number of foreign seeds in 1 pound.* Goosefoot, 100; wormseed mustard, 100; ribgrass, 300; Rugel's plaintain, 700; lady's thumb, 100; green foxtail, 1,400; yellow foxtail, 200; witchgrass, 300; crabgrass, 2,200; embryos, 1,000.	98.4	0.3	1.3
428	From C. M. Conant Co., Bangor, May 5, 1905. *Number of foreign seeds in 1 pound.* Lady's thumb, 300; witchgrass, 200; awned plantain, 300; ribgrass, 500; dooryard plantain, 2,700; tumbleweed, 400; mayweed, 100; green foxtail, 300; yellow foxtail, 400; curled dock, 300; sheep sorrel, 100; embryos, 200; small crab grass, 200; wild turnip, 100.	96.8	0.8	2.4
429	From C. M. Conant Co., Bangor, May 5, 1905. *Number of foreign seeds in 1 pound.* Rugel's plantain, 1,300; green foxtail, 200; sorrel, 200; witchgrass, 100; goosefoot, 200; lady's thumb, 100; embryos, 200.	99.3	0.2	0.5
417	From R. B. Dunning & Co., Bangor, March 31, 1905. *Number of foreign seeds in 1 pound.* Witchgrass, 100; green foxtail, 400; ribgrass, 100; dooryard plantain, 100.	99.3	0.2	0.5
336	From R. B. Dunning & Co., Bangor, March 31, 1905. *Number of foreign seeds in 1 pound.* Timothy, 100; sheep sorrel, 100; sorrel, 100.	99.8	0.1	0.1
422	From A. H. Fogg Co., Houlton, April 25, 1905. *Number of foreign seeds in 1 pound.* Alsike, 200; sorrel, 200.	99.7	0.2	0.1
423	From Geo. B. Haskell Co., Lewiston, April 18, 1905. *Number of foreign seeds in 1 pound.* Timothy, 500; lady's thumb, 200; goosefoot, 200; witchgrass, 200; sorrel, 300; tumble weed, 100; sheep sorrel, 500; ribgrass, 200; Rugel's plantain, 400; embryos, 200.	99.3	0.2	0.5
435	From Geo. B. Haskell Co., Lewiston, April 18, 1905. *Number of foreign seeds in 1 pound.* Green foxtail, 200.	99.8	0	0.2
412	From Oscar Holway Co., Auburn, April 20, 1905. *Number of foreign seeds in 1 pound.* Green foxtail, 400; yellow foxtail, 300; clustered dock, 200; stink grass, 100.	97.3	0.3	2.4
419	From Oscar Holway Co., Auburn, April 20, 1905. *Number of foreign seeds in 1 pound.* Red top, 200; timothy, 4,000; witch grass, 500; sheep sorrel, 1,300; curled dock, 200; wild peppergrass, 100; lady's thumb, 400; Rugel's plantain, 900; green foxtail, 700; yellow foxtail, 300; embryos, 300; small crab grass, 300.	98.	0.4	1.6
438	From Oscar Holway Co., Auburn, April 20, 1905. *Number of foreign seeds in 1 pound.* Awned plantain, 400; ribgrass, 1,300; dooryard plantain, 300; yellow foxtail, 2,800; sorrel, 100.	98.	0.4	1.6

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	RED CLOVER—Continued.	Per ct.	Per ct.	Per ct.
430	From Kendall and Whitney, Portland, April 7, 1905.... *Number of foreign seeds in 1 pound.* Timothy, 100; valerian, 100.	99.9	0	0.1
414	From Shaw, Hammond and Carney, Portland, April 13, 1905 .... *Number of foreign seeds in 1 pound.* Wormseed mustard, 100; green foxtail, 200; yellow foxtail, 100; Rugel's plantain, 200; ribgrass, 3,100; lady's thumb, 200; goosefoot, 100.	99.	0	1.
425	From Shaw, Hammond and Carney, Portland, April 13, 1905........ *Number of foreign seeds in 1 pound.*	99.9	0.01	0
439	From Shaw, Hammond and Carney, Portland, April 13, 1905........ *Number of foreign seeds in 1 pound.* Timothy, 1,800; red top, 300; tumbleweed, 800; witchgrass, 1,400; wild peppergrass, 100; curled dock, 400; sheep sorrel, 100; goosefoot, 200; dooryard plantain, 300; Rugel's plantain, 1,500; yellow foxtail, 200; small crab grass, 200.	96.7	1.1	2.2
437	From A. M. Smith, Presque Isle, April 13, 1905 .... *Number of foreign seeds in 1 pound.* Ribgrass, 100; yellow foxtail, 100.	99.8	0.1	0.1
440	From A. M. Smith, Presque Isle, April 13, 1905............ *Number of foreign seeds in 1 pound.* Ribgrass, 100; green foxtail, 100.	99.8	0	0.2
426	From M. C. Smith, Presque Isle, April 25, 1905............ *Number of foreign seeds in 1 pound.* Timothy, 10,400; tumbleweed, 100; goosefoot, 1,300; awned plantain, 300; ribgrass, 2,100; sheep sorrel, 600; sorrel, 100; green foxtail, 700; yellow foxtail, 1,700; wild mustard, 200; lady's thumb, 600; mayweed, 300; dooryard plantain, 6,000; wild turnip, 100; small crab grass, 500.	95.3	1.0	3.7
433	From M. C. Smith, Presque Isle, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Ribgrass, 100; lady's thumb, 100.	99.9	0	0.1
420	From John C. Watson Co., Houlton, April 25, 1905......... *Number of foreign seeds in 1 pound.* Green foxtail, 200; yellow foxtail, 200; sorrel, 100.	99.5	0.3	0.2
427	From John C. Watson Co., Houlton, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Timothy, 1,500; lady's thumb, 300; green foxtail, 600; yellow foxtail, 200; ribgrass, 300; dooryard plantain, 500; sheep sorrel, 300.	99.1	0.2	0.7
431	From John C. Watson Co., Houlton, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Sorrel, 100; green foxtail, 100.	99.9		.1
432	From John C. Watson Co., Houlton, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Timothy, 3,300; sheep sorrel, 1,900; sorrel, 100; Rugel's plantain, 300; goosefoot, 200.	99.3	0.2	0.5
434	From John C. Watson Co., Houlton, April 25, 1905........ *Number of foreign seeds in 1 pound.* Timothy, 2,900; sorrel, 300; dooryard plantain, 300.	99.6	0.2	0.2

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	CRIMSON CLOVER. (*Trifolium incarnatum.*)	Per ct.	Per ct.	Per ct.
413	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Timothy, 100; red clover, 400; crane's bill, 200; ribgrass, 100; sheep sorrel, 600; wild mustard, 100; night catch fly, 200.	98.9	0.7	0.4
	WHITE CLOVER. (*Trifolium repens.*)			
424	From R. B. Dunning and Co., Bangor, March 31, 1905 .... *Number of foreign seeds in 1 pound.* Timothy, 49,100; wild peppergrass, 500; sheep sorrel, 1,600; night catchfly, 300; mayweed, 600; grass seeds, 400; goosefoot, 100; five-finger, 800; dooryard plantain, 11,000.	94.8	0.9	4.3
421	From G. B. Haskell Co., Lewiston, April 18, 1905......... *Number of foreign seeds in 1 pound.* Timothy, 100; goosefoot, 100; sheep sorrel, 400; dooryard plantain, 600; Rugel's plantain, 200.	99.5	0.3	0.2
415	From Kendall and Whitney, Portland, April 7, 1905 ..... *Number of foreign seeds in 1 pound.* Alsike, 600; timothy, 1,000; red top, 200; dooryard plantain, 5,400; white dock, 800; mayweed, 100; Rugel's plantain, 1,000.	98.8	0.4	0.8
	ALSIKE. (*Trifolium hybridum.*)			
451	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* Timothy, 75,400; sheep sorrel, 2,000; small crab grass, 100.	94.5	0.9	4.6
441	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* Red top, 1,200; timothy, 2100; sheep sorrel, 2,300; lady's thumb, 100.	99.4	0.2	0.4
449	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Timothy, 27,800; red top, 300; sheep sorrel, 800; rib grass, 100; yellow foxtail, 200; five-finger, 100; dooryard plantain, 100; nerved manna grass, 200.	96.1	0.8	3.1
446	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Timothy, 3,600; witch grass, 100; sheep sorrel, 300; winged pigweed, 100.	98.9	0.5	0.6
452	From A. H. Fogg Co., Houlton, April 25, 1905............. *Number of foreign seeds in 1 pound.* Timothy, 500.	99.8	0.1	0.1
445	From Harmon and Harris, Portland, April 10, 1905...... *Number of foreign seeds in 1 pound.* Timothy, 92,000; sheep sorrel, 500; goosefoot, 100; night catchfly, 200.	91.5	0.6	7.9
442	From Geo. B. Haskell Co., Lewiston, April 18, 1905...... *Number of foreign seeds in 1 pound.* Red top, 200; timothy, 16,700; sheep sorrel, 1,600; dooryard plantain, 100.	97.9	0.6	1.5
456	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Timothy, 8,300; red clover, 100; red top, 200; sheep sorrel, 200; dooryard plantain, 200; gum weed, 100.	98.8	0.3	0.9

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	ALSIKE—Continued.	Per ct.	Per ct.	Per ct.
454	From Kendall and Whitney, Portland, April 7, 1905..... *Number of foreign seeds in 1 pound.* Timothy, 35,000; sheep sorrel, 1,500; false flax, 100; night catchfly, 200.	96.2	0.3	3.5
450	From Shaw, Hammond and Carney, Portland, March 31, 1905........ *Number of foreign seeds in 1 pound.* Timothy, 17,500; red top, 1,800; sheep sorrel, 500; unripe seed, 100.	97.2	0.8	2.00
444	From Shaw, Hammond & Carney, Portland, April 13, 1905 *Number of foreign seeds in 1 pound.* Timothy, 96,000; sheep sorrel, 800.	90.7	0.5	8.8
446	From A. M. Smith, Presque Isle, April 25, 1905. .... *Number of foreign seeds in 1 pound.* Timothy, 1,200; sheep sorrel, 100.	99.3	0.4	0.3
455	From M. C. Smith, Presque Isle, April 25, 1905............ *Number of foreign seeds in 1 pound.* Timothy, 11,500; red top, 100; sheep sorrel, 1,500; catchfly, 100; nerved manna grass, 400.	98.3	0.4	1.3
453	From M. C. Smith, Presque Isle, April 25, 1905........... *Number of foreign seeds in 1 pound.* Timothy, 1,100; sheep sorrel, 100.	99.8	0.1	0.1
447	From John Watson Co., Houlton, April 25, 1905........... *Number of foreign seeds in 1 pound.* Timothy, 3,600; sheep sorrel, 200; wild peppergrass, 100.	99.5	0.1	0.4
448	From John Watson Co., Houlton, April 25, 1905.......... *Number of foreign seeds in 1 pound.* Timothy, 15,400; sheep sorrel, 400.	98.6	0.5	0.9
	ALFALFA. (*Medicago sativa.*)			
457	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Red top, 100; alsike, 100; ribgrass, 100; winged pigweed, 100; yellow foxtail, 200.	99.2	0.5	0.3
	HUNGARIAN GRASS. (*Ixophorus italicus.*)			
458	From Harmon and Harris, Portland, April 10, 1905 ...... *Number of foreign seeds in 1 pound.* Timothy, 100; winged pigweed, 400; Pennsylvania persicaria, 200; lady's thumb, 300, green foxtail, 100; witchgrass, 100; gum weed, 200; large crabgrass, 2,300.	99.2	0.1	0.7
460	From Geo. B. Haskell Co., Lewiston, April 18, 1905 ...... *Number of foreign seeds in 1 pound.* Red top, 100; goosefoot, 700; pigweed, 300; witchgrass, 4,400; gumweed, 100; lady's thumb, 300; winged pigweed, 100; large crab grass, 600.	98.8	0.5	0.7
459	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Lady's thumb, 400; winged pigweed, 100; goosefoot, 100; yellow foxtail, 100; large crabgrass, 400.	99.1	0.5	0.4
461	From Shaw, Hammond & Carney, Portland, Apr. 13, 1905 *Number of foreign seeds in 1 pound.* Timothy, 100; lady's thumb, 800; sorrel, 100; winged pigweed, 200; witchgrass, 100.	99.3	0.3	0.4
462	From Kendall and Whitney, Portland, April 7, 1905...... *Number of foreign seeds in 1 pound.* Lady's thumb, 500; winged pigweed, 1,000; gum weed, 400; large crab grass, 800.	99.4	0.1	0.

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	BARLEY. (*Hordeum vulgare.*)	Per ct.	Per ct.	Per ct.
463	From Kendall and Whitney, Portland, April 7, 1905...... Practically no impurities present, either foreign seed or mechanical.	100.	0	0
	OATS. (*Avena sativa.*)			
464	From Kendall and Whitney, Portland, April 7, 1905..... Practically 100 per cent pure.	100.	0	0
	SIBERIAN MILLET.			
465	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Hungarian, 1,500; tumbleweed, 100; winged pigweed, 100; curled dock, 100; green foxtail, 4,600; yellow foxtail, 1,600.	98.	0.3	1.7
	TIMOTHY. (*Phleum pratense.*)			
482	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* Red clover, 800; alsike, 500; red top, 3,000; five-finger, 400; dooryard plantain, 200; goosefoot, 100; lady's thumb, 200.	99.	0.4	0.6
480	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* White clover, 600; red clover, 100; sheep sorrel, 100; wild peppergrass, 200; yellow daisy, 300; blue vervain, 300; white vervain, 300.	99.5	0.2	0.3
477	From C. M. Conant Co., Bangor, May 5, 1905............. *Number of foreign seeds in 1 pound.* White clover, 200; red clover, 100; alsike, 300; red top, 200; sheep sorrel, 200; dooryard plantain, 200; lady's thumb, 200.	99.8	0.1	0.1
493	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* White clover, 100; sheep sorrel, 100; large spurge, 100.	99.9	0	0.1
492	From R. B. Dunning and Co., Bangor, March 3, 1905..... *Number of foreign seeds in 1 pound.* White clover, 800; hungarian, 100; five-finger, 100.	99.8	0.1	0.1
481	From R. B. Dunning and Co., Bangor, March 3, 1905..... *Number of foreign seeds in 1 pound.* Red clover, 100; winged pigweed, 200; evening primrose, 100; blue vervain, 100.	99.7	0.1	0.2
473	From R. B. Dunning and Co., Bangor, March 3, 1905.... *Number of foreign seeds in 1 pound.* Red clover, 900; alsike, 100; goosefoot, 300; wild peppergrass, 100; winged pigweed, 300; sheep sorrel, 100; dooryard plantain, 1,200.	99.2	0.2	0.6
486	From A. H. Fogg Co., Houlton, April 25, 1905............. *Number of foreign seeds in 1 pound* Red clover, 300; night catch-fly, 100; yellow daisy, 100; blue vervain, 100; white vervain, 100; ragweed, 100.	99.8	0.1	0.1
475	From A. H. Fogg, Houlton, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Alsike, 200; sheep sorrel, 100; mayweed, 100.	99.9	0	0.1
494	From Harmon and Harris, Portland, April 10, 1905 ...... White clover, 500; goosefoot, 100.	99.6	0.2	0.2

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	TIMOTHY—Continued.	Per ct.	Per ct.	Per ct.
483	From Harmon and Harris, Portland, April 10, 1905...... *Number of foreign seeds in 1 pound.* Al sike, 800; winged pigweed, 500; dooryard plantain, 1'300; yellow daisy, 100; blue vervain, 200; ragweed, 200; white vervain, 100.	99.3	0.2	0.5
479	From Geo. B. Haskell Co., Lewiston, April 18, 1905...... *Numberof foreign seeds in 1 pound.* Alsike, 100; lady's thumb, 100; dooryard plantain, 100.	99.8	0.1	0.1
476	From Geo. B. Haskell Co., Lewiston, April 18, 1905...... *Number of foreign seeds in 1 pound.* Red clover, 100; wild peppergrass, 100; tumbleweed, 100; penny cress, 100; lady's thumb, 100; blue vervain, 300; ragweed, 200.	99.3	0.4	0.3
466	From Geo. B. Haskell Co., Lewiston, April 18, 1905...... *Number of foreign seeds in 1 pound.* Red top, 3,900; alsike, 300; Rugel's plantain, 700; dooryard plantain, 400; wild p eppergrass, 100; yellow foxtail, 100; five-finger, 400; sheep sorrel, 200; yellow daisy, 300; blue, vervain, 100; white vervain, 100.	99.4	0.2	0.4
491	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Red clover, 100.	99.9	0	0.1
474	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Red clover, 600; alsike, 200; ribgrass, 100; dooryard plantain, 3,000; Rugel's plantain, 800; sheep sorrel, 500; wild peppergrass, 100; winged pigweed, 300; polygonum persicaria, 200; yellow daisy, 100; blue vervain, 100; white vervain, 100.	98.8	0.3	0.9
490	From Kendall and Whitney, Portland, April 7, 1905...... *Number of foreign seeds in 1 pound.* Alsike, 500; red clover, 300; red top, 2,300; five finger, 4,700; dooryard plantain, 400; winged pigweed, 400; wild peppergrass, 100; sheep sorrel, 200; yellow daisy, 200; blue vervain, 600; white vervain, 100; ragweed, 300.	98.9	0.6	0.5
467	From Kendall and Whitney, Portland, April 7, 1905...... *Number of foreign seeds in 1 pound* Alsike, 200; mayweed, 100; dried up and unidentified seeds, 300.	99.6	0.2	0.2
489	From Shaw, Hammond & Carney, Portland, April 13, 1905 *Number of foreign seeds in 1 pound.* Red clover, 500; white clover, 100; dooryard plantain, 400; winged pigweed, 100; five-finger, 500.	99.6	0.2	0.2
485	From Shaw, Hammond & Carney, Portland, April 13, 1905 *Number of foreign seeds in 1 pound.* Red top, 5,100; red clover, 1,400; alsike, 600; Rugel's plantain, 2,000; dooryard plantain, 2,300; winged pigweed, 300; five finger, 4,500; sheep sorrel, 600; sorrel, 100; wild peppergrass, 200; witch grass, 100; yellow foxtail, 100; yellow daisy, 100; blue vervain, 300; ragweed, 300; white vervain, 200.	96.8	1.0	2.2
470	From Shaw Hammond & Carney, Portland, April 13, 1905 *Number of foreign seeds in 1 pound.* Red top, 1,500; red clover, 300; alsike, 200; dooryard plantain, 400; wild peppergrass, 100.	99.6	0.1	0.3

Analysis of seeds, Station samples—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	TIMOTHY—Continued.	Per ct.	Per ct.	Per ct.
469	From A. M. Smith, Presque Isle, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Alsike, 2,800; red clover, 1,000; red top, 1,400; five finger, 200; dooryard plantain, 800; oxeye daisy, 200; sheep sorrel, 200; black mustard, 100.	98.5	0.3	1.2
468	From A. M. Smith, Presque Isle, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Alsike, 300; sheep sorrel, 100; winged pigweed, 100.	99.7	0.1	0.2
472	From M. C. Smith, Presque Isle, April 25, 1905 .... *Number of foreign seeds in 1 pound.* Rugel's plantain, 100; mayweed, 100.	99.8	0.1	0.1
471	From M. C. Smith, Presque Isle, April 25, 1905............ *Number of foreign seeds in 1 pound.* Red clover, 100; dooryard plantain, 100; winged pigweed, 200; large spurge, 200.	99.6	0.1	0.3
488	From John Watson Co., Houlton, April 25, 1905.......... *Number of foreign seeds in 1 pound.* White clover, 200; winged pigweed, 500; sheep sorrel, 100; yellow daisy, 200; blue vervain, 100; white vervain, 100; ragweed, 100.	99.5	0.2	0.3
487	From John Watson Co., Houlton, April 25, 1905.......... *Number of foreign seeds in 1 pound.* No foreign seeds were present.	99.9	0.1	0
484	From John Watson Co., Houlton, April 25, 1905.......... *Number of foreign seeds in 1 pound.* White clover, 1,000; sheep sorrel, 700.	99.8	0	0.2
478	From John Watson Co., Houlton, April 25, 1905.......... *Number of foreign seeds in 1 pound.* Alsike, 500; red top, 600; winged pigweed, 200; goosefoot, 100; yellow foxtail, 200; wild peppergrass, 100; yellow daisy, 200; blue vervain, 500; white vervain, 200; ragweed, 200.	99.3	0.2	0.5
486	From A. H. Fogg Co., Houlton, April 25, 1905............. *Number of foreign seeds in 1 pound.* Night catchfly, 100; red clover, 200; yellow daisy, 100; blue vervain, 100; white vervain, 100; ragweed, 100.	99.8	0.1	0.1
	RED TOP. (*Agrostis alba vulgaris.*)			
507	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* Timothy, 167,000; sheep sorrel, 3,400.	93.	0.5	6.5
504	From C. M. Conant Co., Bangor, May 5, 1905.............. *Number of foreign seeds in 1 pound.* Timothy, 170,800; hungarian, 200; sheep sorrel, 600; lady's thumb, 400.	89.9	0.5	9.6
500	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Timothy, 90,800; five-finger, 29,400; dooryard plantain, 3,400; yellow daisy, 400; blue vervain, 400; white vervain, 200.	94.7	0.9	4.
498	From R. B. Dunning and Co., Bangor, March 31, 1905 ... *Number of foreign seeds in 1 pound.* Timothy, 268,200; five-finger, 400; dooryard plantain, 600.	83.7	0.7	15.6

Analysis of seeds, Station samples—Concluded:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	TIMOTHY--Continued.	Per ct.	Per ct.	Per ct.
505	From Harmon and Harris, Portland, April 10, 1905...... *Number of foreign seeds in 1 pound.* Timothy, 24,800; five-finger, 19,200; dooryard plantain, 12,600.	85.2	0.6	14.2
499	From Harmon and Harris, Portland, April 10, 1905 ...... *Number of foreign seeds in 1 pound.* Timothy, 1,600; catchfly, 1,000; dooryard plantain, 400.	99.2	0.5	0.3
502	From Geo. B. Haskell Co., Lewiston, April 18, 1905 ...... *Number of foreign seeds in 1 pound.* Timothy, 2,400; dooryard plantain, 400; catchfly, 200.	99.4	0.4	0.2
496	From Geo. B. Haskell Co., Lewiston, April 18, 1905...... *Number of foreign seeds in 1 pound* Timothy, 99,600; five-finger, 2,400; dooryard plantain, 2,800; wild peppergrass, 400.	99.3	0.1	0.6
506	From Oscar Holway Co., Auburn, April 20, 1905... ...... *Number of foreign seeds in 1 pound.* Timothy, 128,000; five-finger, 20,000; dooryard plantain, 2,000; lady's thumb, 1,400.	92.1	0.3	7.6
503	From Oscar Holway Co., Auburn, April 20, 1905 .... *Number of foreign seeds in 1 pound.* Timothy, 114,000; dooryard plantain, 2,000.	94.2	0.3	5.5
501	From Oscar Holway Co., Auburn, April 20, 1905.......... *Number of foreign seeds in 1 pound.* Timothy, 800; five-finger, 200; dooryard plantain, 1,000; ragweed, 400; blue vervain, 200.	99.5	0.2	0.3
509	From Kendall and Whitney, Portland, April 7, 1905 ..... *Number of foreign seeds in 1 pound.* Timothy, 179,400; five-finger, 9,400; dooryard plantain, 2,000.	93.3	0.1	6.6
842	From Kendall and Whitney, Portland, April 7, 1905 ..... *Number of foreign seeds in 1 pound.* Timothy, 168,400; five-finger, 5,200; dooryard plantain, 1,600; sheep sorrel, 600.	90.0	1.0	9.0
508	From Shaw, Hammond & Carney, Portland, Apr. 13, 1905 *Number of foreign seeds in 1 pound.* Timothy, 61,200; five-finger, 1,400; dooryard plantain, 400.	95.2	1.1	3.7
495	From Shaw, Hammond & Carney, Portland, April, 13,1905 *Number of foreign seeds in 1 pound.* Alsike, 200; timothy, 6,400; five-finger, 8,800; wild peppergrass, 200; dooryard plantain, 200.	98.3	1.0	0.7
	ORCHARD GRASS. (*Dactylis glomerata.*)			
510	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Red clover, 200; red top, 1,000; sorrel, 600; ribgrass, 200.	97.8	1.9	0.3
	KENTUCKY BLUE GRASS. (*Poa pratensis.*)			
511	From R. B. Dunning and Co., Bangor, March 31, 1905.... *Number of foreign seeds in 1 pound.* Red clover, 200; alsike, 200; orchard grass, 200; timothy, 200; sheep sorrel, 200; lady's thumb, 200.	98.8	0.8	0.4
	LAWN SEED.			
512	From Geo. B. Haskell Co., Lewiston, May 5, 1905......... *Number of foreign seeds in 1 pound.* Sheep sorrel, 4,000; dooryard plantain, 1,000.	97.7	1.5	.8

Analysis of seeds. Samples sent to the Station by correspondents in the years 1902-5.

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	RED CLOVER. (*Trifolium pratense.*)	Per ct.	Per ct.	Per ct.
406	From R. B. Dunning and Co., Bangor, April 15, 1905 ..... *Number of foreign seeds in 1 pound.* Crimson clover, 1,400; timothy, 100; tall dock, 200.	99.2	0.2	0.6
318	From A. H. Fogg Co., Houlton, February 22, 1902 .... *Number of foreign seeds in 1 pound.* Timothy, 200; green foxtail, 1,100.	99.9	0	0.1
326	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Timothy, 200; green foxtail, 1,700; unidentified, 1,100.	99.4	0.1	0.5
328	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Timothy, 1,300; green foxtail, 400; bitter dock, 100; lady's thumb, 100.	99.7	0	0.3
332	From H. N. Goodhue, Fort Fairfield, April 7, 1902........ *Number of foreign seeds in 1 pound.* Timothy, 100; green foxtail, 900; lamb's quarters, 100; ragweed, 100.	99.7	0	0.3
364	From H. N. Goodhue, Fort Fairfield, April 16, 1903....... *Number of foreign seeds in 1 pound.* Timothy, 300; green foxtail, 400; peppergrass, 300.	99.5	0.2	0.3
368	From H. N. Goodhue, Fort Fairfield, April 22, 1903....... *Number of foreign seeds in 1 pound.* Timothy, 1,200; green foxtail, 300; ribgrass, 200; sheep sorrel, 200; white dock, 100.	99.3	0.3	0.4
371	From H. N. Goodhue, Fort Fairfield, April 22, 1903....... *Number of foreign seeds in 1 pound.* Timothy, 200; green foxtail, 100.	99.7	0.2	0.1
388	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 1,100; green foxtail, 600; pigweed, 100; sheep sorrel, 300; white dock, 600.	99.6	0.1	0.3
387	From Geo. B. Haskell Co., Lewiston, March 24, 1904 ..... *Number of foreign seeds in 1 pound.* Timothy, 200; ribgrass, 200.	99.9	0	0.1
388	From Geo. B. Haskell Co., Lewiston, March 24, 1904 ..... *Number of foreign seeds in 1 pound.* Timothy, 4,200; green foxtail, 400; lady's thumb, 300; sheep sorrel, 200.	99.5	0.2	0.3
389	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 7,300; green foxtail, 600; ribgrass, 300; lady's thumb, 100; sheep sorrel, 300.	99.3	0.4	0.3
340	From H. N. Knight, Fort. Fairfield, April 7, 1902.......... *Number of foreign seeds in 1 pound.* Green foxtail, 1,000; bitter dock, 100; black mustard, 100.	99.6	0.1	0.3
341	From H. N. Knight, Fort Fairfield, April 7, 1902.......... *Number of foreign seeds in 1 pound.* Green foxtail, 800; lady's thumb, 100.	99.5	0.1	0.4

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	RED CLOVER—Continued.	Per ct.	Per ct.	Per ct.
330	From C. H. Moody, Turner, March 22, 1902................ *Number of foreign seeds in 1 pound.* Timothy, 1,200; white clover, 300; green foxtail, 2,100; sheep sorrel, 400; ribgrass, 400; lamb's quarters, 600; some species of polygonum, 300.	98.8	0.3	0.9
337	From C. H. Moody, Turner, April 7, 1902.................. *Number of foreign seeds in 1 pound.* Timothy, 1,000; green foxtail, 2,800.	99.4	0.2	0.4
338	From C. H. Moody, Turner, April 7, 1902................. *Number of foreign seeds in 1 pound.* Timothy, 100; green foxtail, 100; dooryard plantain, 200.	99.7	0.2	0.1
365	From A. D. Nutter and Co., Mars Hill, April 17, 1903..... *Number of foreign seeds in 1 pound.* Timothy, 7,900; green foxtail, 500; white dock, 100; ribgrass, 1,300; awned plantain, 100; lamb's quarters, 100.	98.1	0.4	1.5
302	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Sorrel, 100; five-finger, 100.	99.	0.5	0.5
309	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Unidentified seed, 600.	99.6	0	0.4
346	From H. B. Whipple, Bingham, April 23, 1902............ *Number of foreign seeds in 1 pound.* Timothy, 400; green foxtail, 900; wild buckwheat, 100; orache, 200.	99.4	0.5	0.1
355	From H. B. Whipple, Bingham, Feb. 11, 1903.............. *Number of foreign seeds in 1 pound.* Timothy, 3,800; green foxtail, 1,700; ribgrass, 100; careless weed, 300; lamb's quarters, 200.	99	0.2	0.8
	WHITE CLOVER. (*Trifolium repens.*)			
304	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Timothy, 2,600; dooryard plantain, 5,500; sorrel, 600; unidentified, three species, 1,600.	98.6	0.6	0.8
	MAMMOTH CLOVER. (*Trifolium medium.*)			
407	From R. B. Dunning and Co., Bangor, April 15, 1905..... *Number of foreign seeds in 1 pound.* Timothy, 400; crimson clover, 800; white dock, 200; sheep sorrel, 100; vervain, 100.	99.4	0.1	0.5
317	From A. H Fogg Co., Houlton, Feb. 22, 1902.............. *Number of foreign seeds in 1 pound.* Timothy, 4,300; green foxtail, 200; yellow foxtail, 100; mustard, 2,500.	98.3	0.9	0.8
	ALSIKE (*Trifolium hybridum.*)			
357	From R. B. Dunning and Co., Bangor, March 21, 1903.... *Number of foreign seeds in 1 pound.* Timothy, 21,500; green foxtail, 100; sheep sorrel, 500.	98.8	0.2	1.0
358	From R. B. Dunning and Co., Bangor, March 21, 1903.... *Number of foreign seeds in 1 pound.* Timothy, 35,000, sheep sorrel, 1,100; peppergrass, 500.	96.5	1.0	2.5
407	From R. B. Dunning and Co., Bangor, April 15, 1905..... *Number of foreign seeds in 1 pound.* Red top, 100; timothy, 3,700; bitter dock, 200; Rugel's plantain, 100; nettled-leaved goosefoot, 500.	98.3	1.2	0.5

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	ALSIKE—Continued.	Per ct.	Per ct.	Per ct.
319	From A. H. Fogg Co., Houlton, Feb. 22, 1902 .... *Number of foreign seeds in 1 pound.* Timothy, 17,800; white clover, 2,100; medicago, 1,200; careless weed, 100; sorrel, 300; unidentified, 1,400.	96.4	0.5	3.1
320	From A. H. Fogg Co., Houlton, Feb. 22, 1902 .... *Number of foreign seeds in 1 pound.* Timothy, 5,600; white clover, 1,600; mammoth clover, 500; sorrel, 200; English catchfly, 200.	98.8	0.4	0.8
322	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Clover, 300; timothy, 3,800; purslane, 200; sorrel, 400.	99.6	0.1	0.3
323	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Timothy, 22,700; sorrel, 300; peppergrass, 200; unidentified, 200.	98.8	0.3	0.9
367	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Timothy, 11,900; green foxtail, 200; sheep sorrel, 1,400; peppergrass, 100.	98.2	0.3	1.5
369	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Timothy, 3,100; sheep sorrel, 500; peppergrass, 200; prostrate pigweed, 100.	99.3	0.1	0.6
379	From Geo. B. Haskell Co., Lewiston, March 24, 1904...... *Number of foreign seeds in 1 pound.* Red top, 4,700; timothy, 600; white dock, 300; peppergrass, 100.	99.3	0.4	0.3
380	From Geo. B. Haskell Co., Lewiston, March 24, 1904 ..... *Number of foreign seeds in 1 pound.* Timothy, 25,000; red top, 300; ribgrass, 100; sheep sorrel, 5,300.	99.2	0.3	0.5
382	From Geo. B. Haskell Co., Lewiston, March 24, 1904...... *Number of foreign seeds in 1 pound.* Timothy, 100; ribgrass, 100; sheep sorrel, 2,700.	99.2	0.2	0.6
385	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 4,700; peppergrass, 200; pigweed, 100; sheep sorrel, 100.	99.7	0.1	0.2
339	From H. N. Knight, Fort Fairfield, April 7, 1902.......... *Number of foreign seeds in 1 pound.* Timothy, 50,000; sorrel, 1,000; buckwheat, 1,500.	95.	1.0	4.0
329	From C. H. Moody, Turner, March 22, 1902................ *Number of foreign seeds in 1 pound.* Timothy, 31,100; white clover, 400; sheep sorrel, 1,000; careless weed, 400; buckwheat, 500.	97.3	0.8	1.9
333	From C. H. Moody, Turner, April 7, 1902.................. *Number of foreign seeds in 1 pound.* Timothy, 19,700; red clover, 100; sorrel, 400.	98.2	0.9	0.9
334	From C. H. Moody, Turner, April 8, 1902.................. *Number of foreign seeds in 1 pound.* Timothy, 25,000; white clover, 200; red clover, 400; polygonum sp. 500.	97.8	1.0	1.2

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	ALSIKE—Continued.	Per ct.	Per ct.	Per ct.
301	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Timothy, 6,300; red clover, 200; red top, 200.	98.3	0.5	1.2
308	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Timothy, 28,300; unidentified, 500.	97.3	0.4	2.3
354	From H. B. Whipple, Bingham, Feb. 11, 1903.............. *Number of foreign seeds in 1 pound.* Timothy, 22,000; sheep sorrel, 100.	98.	0.5	1.5
	TIMOTHY. (*Phleum pratense.*)			
361	From E. T. Bailey, Oakland, April 3, 1903................. *Number of foreign seeds in 1 pound.* White clover, 700; red top, 1,900; red clover, 300; peppergrass, 200; lambs quarters, 100.	99.1	0.4	0.5
403	From Brackett and Russell, Norridgewock, April 3, 1905 *Number of foreign seeds in 1 pound.* Alsike, 400; red clover, 1,100; white clover, 1,400; five finger, 2,800; Rugel's plantain, 1,200; yellow daisy, 400; unidentified, 24,500.	95.6	1.2	3.2
402	From L. Decker, Clinton, April 3, 1905.................... *Number of foreign seeds in 1 pound.* Alsike, 200; red clover, 1,800; yellow daisy, 400; Rugel's plantain, 300.	97.7	0.4	1.9
404	From L. Decker, Clinton, April 11, 1905................... *Number of foreign seeds in 1 pound.* Red clover, 1,200; five-finger, 3,900; red top, 2,200; Rugel's plantain, 100; dooryard plantain, 300; green foxtail, 100; yellow daisy, 100; unidentified, 1,800.	98.5	0.7	0.8
359	From R. B. Dunning and Co., Bangor, March 23, 1903.... *Number of foreign seeds in 1 pound.* Red top, 300.	99.5	0.5	0
360	From R. B. Dunning and Co., Bangor, March 31, 1903.... *Number of foreign seeds in 1 pound.* Red top, 10,800; peppergrass, 400.	98.5	1.0	0.5
348	From E. H. Fernald, Presque Isle, April 29, 1902.......... *Number of foreign seeds in 1 pound.* Red top, 800; careless weed, 500; peppergrass, 2,200; ox-eye daisy, 500.	99.3	0.5	0.2
349	From R. W. Fitzgerald, Presque Isle, May 6, 1902........ *Number of foreign seeds in 1 pound.* Alsike, 1,000; careless weed, 400; yellow daisy, 1,200; sheep sorrel, 200.	98.8	0.8	0.4
315	From A. H. Fogg Co., Houlton, Feb. 22, 1902.............. *Number of foreign seeds in 1 pound.* White clover, 100; peppergrass, 900; green foxtail, 200.	99.3	0.4	0.3
316	From A. H. Fogg Co., Houlton, Feb. 22, 1902.............. *Number of foreign seeds in 1 pound.* White clover, 8,000; red clover, 1,000; peppergrass, 300.	97.5	0.5	2.0
324	From H. N. Goodhue, Fort Fairfield, May 20, 1902........ Only mechanical impurities present.	99.9	0.1	0

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	TIMOTHY—Continued.	Per ct.	Per ct.	Per ct
325	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... *Number of foreign seeds in 1 pound.* Red clover, 400; green foxtail, 100; peppergrass, 500.	99.6	0.3	0.1
327	From H. N. Goodhue, Fort Fairfield, March 20, 1902...... Only mechanical impurities present.	99.9	0.1	0
362	From H. N. Goodhue, Fort Fairfield, April 16, 1903....... *Number of foreign seeds in 1 pound.* Alsike, 400; white clover, 200; peppergrass, 800; sheep sorrel, 200.	98.9	0.7	0.4
363	From H. N. Goodhue, Fort Fairfield, April 6, 1903....... *Number of foreign seeds in 1 pound.* White clover, 200; green foxtail, 100; peppergrass, 100.	99.2	0.6	0.2
366	From H. N. Goodhue, Fort Fairfield, April 22, 1903...... *Number of foreign seeds in 1 pound.* Red top, 200; peppergrass, 200.	99.7	0.2	0.1
370	From H. N. Goodhue, Fort Fairfield, April 22, 1903....... *Number of foreign seeds in 1 pound.* Red top, 300; sheep sorrel, 300.	99.7	0.2	0.1
379	From H. T. Harmon and Co., Portland, March 24, 1904... *Number of foreign seeds in 1 pound.* Red clover, 300; peppergrass, 700; lady's thumb, 100; yellow daisy, 200; sheep sorrel, 100.	99.5	0.3	0.2
376	From Harmon and Harris Co., Portland, Nov. 10, 1903... *Number of foreign seeds in 1 pound.* White clover, 300; Kentucky blue-grass, 200; peppergrass, 500; careless weed, 100; lambs quarters, 100.	98.8	0.7	0.5
377	From Harmon and Harris Co., Portland, Nov. 10, 1903... *Number of foreign seeds in 1 pound.* Green foxtail, 300; Kentucky blue-grass, 200; peppergrass, 200; careless weed, 300; sheep sorrel, 400.	99.5	0.2	0.3
390	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Red clover, 200; peppergrass, 1,300; yellow daisy, 300; sheep sorrel, 500; careless weed, 300.	99.5	0.2	0.3
391	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Red top, 700; green foxtail, 100; peppergrass, 500; sheep sorrel, 400; careless weed, 100.	99.7	0.2	0.1
392	From Geo. B. Haskell Co., Lewiston, March 24, 1905..... *Number of foreign seeds in 1 pound.* Red clover, 200; careless weed, 100.	99.9	0.1	0
393	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Red clover, 600; peppergrass, 300; sheep sorrel, 700; lamb's quarters, 300.	99.7	0.1	0.2
401	From Geo. B. Haskell Co., Lewiston, June 27, 1905....... *Number of foreign seeds in 1 pound.* Red clover, 300; peppergrass, 600; yellow daisy, 700; sheep sorrel, 800.	99.5	0.2	0.3

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	TIMOTHY—Continued.	Per ct.	Per ct.	Per ct.
405	From Geo. B. Haskell Co., Lewiston, April 13, 1905 .... *Number of foreign seeds in 1 pound.* Red top, 9,200; five-finger, 1,900; alsike, 700; white clover, 1,200; sweet clover, 200; yellow daisy, 300; Rugel's plantain, 700; sheep sorrel, 100; lamb's quarters, 200; unidentified, 1,700.	97.9	0.6	1.5
342	From H. W. Knight, Fort Fairfield, April 7, 1902 .... Mechanical impurities only.	99.4	0.6	0
343	From H. W. Knight, Fort Fairfield, April 7, 1902 .... *Number of foreign seeds in 1 pound.* Careless weed, 400; plantain, 300.	99.8	0.1	0.1
344	From H. W. Knight, Fort Fairfield, April 7, 1902 .... *Number of foreign seeds in 1 pound.* Red clover, 300; plantain, 200; peppergrass, 100.	99.2	0.6	0.2
409	From A. J. McNaughton, May 3, 1905 .... *Number of foreign seeds in 1 pound.* Red top, 3,600; crimson clover, 100; alsike, 500; red clover, 500; five-finger, 500; summer savory, 100; white vervain, 200; Rugel's plantain, 2,500; yellow daisy, 300; lamb's quarters, 200; sheep sorrel, 1,200; unidentified, 800.	98.0	1.4	0.6
331	From C. H. Moody, Turner, March 22, 1902 .... *Number of foreign seeds in 1 pound.* Red top, 800; peppergrass, 500; lamb's quarters, 400.	99.3	0.5	.02
335	From C. H. Moody, Turner, April 7, 1902.................. *Number of foreign seeds in 1 pound.* Red top, 600; peppergrass, 500; careless weed, 400; yellow daisy, 300.	99.6	0.2	0.2
336	From C. H. Moody, Turner, April 8, 1902.................. *Number of foreign seeds in 1 pound.* Peppergrass, 500; yellow daisy, 300; plantain, 200.	98.5	1.4	0.1
303	From Shaw, Hammond and Carney, Portland, Dec.3, 1901 *Number of foreign seeds in 1 pound.* Clover, 900; red top, 700; unidentified, 900.	99.4	0.3	0.3
305	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Red clover, 2,300; white clover, 700; red top, 3,300; sorrel, 100; unidentified, 400.	98.8	0.5	0.7
307	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Red top, 500; alsike, 1,900; grass, 1,100; sorrel, 1,000; five-finger, 2,000.	98.7	0.7	0.6
310	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Alsike, 6,000; plantain, 1,400; yellow daisy, 900; five-finger, 2,000; unidentified, 300.	97.2	1.5	1.3
351	From Swan and Sibley Co., Belfast, October 20, 1902..... *Number of foreign seeds in 1 pound.* Red top, 1,300; prostrate pigweed, 100; oxeye daisy, 300.	99.	0.6	0.4
352	From Swan and Sibley Co., Belfast, October 20, 1902..... *Number of foreign seeds in 1 pound.* Red top, 6,500; peppergrass, 400; oxeye daisy, 200.	98.	1.5	.5

Analysis of seeds from correspondents—Continued:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seeds.	Inert matter.	Foreign seeds.
	TIMOTHY—Continued.	Per ct.	Per ct.	Per ct.
372	From Swan and Sibley Co., Belfast, Octobsr 20, 1902..... *Number of foreign seeds in 1 pound.* Sorrel and polygonum present.	99.1	0.2	0.7
373	From Swan and Sibley Co., Belfast, October 20, 1902..... Mechanical impurities only.	99.5	0.5	0
374	From Swan and Sibley Co., Belfast, October 20, 1002..... Co siderable wild carrot and sorrel.	80.		
375	From Swan and Sibley Co., Belfast, October 20, 1902..... No noxious weeds.	99.4	0.4	0.2
398	From Swan and Sibley Co., Belfast, December 14, 1904 .. Practically pure.	100	0	0
399	From Swan and Sibley Co., Belfast, December 14, 1904 .. *Number of foreign seeds in 1 pound.* Red top, 500; red clover, 100; peppergrass, 100; Rugel's plantain, 1,000; yellow daisy, 100.	99.8	0.1	0.1
400	From Swan and Sibley Co., Belfast, December 14, 1904 .. *Number of foreign seeds in 1 pound.* Red clover, 500; German millet, 100; yellow daisy, 500; lamb's quarters, 300; sheep sorrel, 100.	99.9	0	0.1
378	From Wm. Wood and Sons, Gardiner, March 19, 1904.... *Number of foreign seeds in 1 pound.* White clover, 500; red top, 200; sheep sorrel, 200; lamb's quarters, 400.	99.6	0.4	0.2
	RED TOP. (*Agrnstis alba vulgaris.*)			
356	From R. B. Dunning and Co., Bangor, March 21, 1903 .... *Number of foreign seeds in 1 pound.* Timothy, 41,500; peppergrass, 900.	97.	1.3	1.7
411	From R. B. Dunning and Co., Bangor, June 22, 1905. ..... *Number of foreign seeds in 1 pound.* Timothy, 6,800; red clover, 400; peppergrass, 700; sheep sorrel, 300; white weed, 1,800.	97.5	2.	0.5
381	From Geo. B. Haskell Co., Lewiston, Nov. 24, 1904....... *Number of foreign seeds in 1 pound.* Timothy, 90,475; sheep sorrel, 525; peppergrass, 1,050.	98.6	0.4	1.0
383	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 38,325; creeping bent, 9,975; slender fescue, 1,575; peppergrass, 875; sheep sorrel, 525.	99.0	0.4	0.6
384	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 44,285; pigweed, 175; peppergrass, 1,275.	99.3	0.2	0.5
394	From Geo. B. Haskell Co., Lewiston, March 31, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 64,220; peppergrass, 350; pigweed, 350.	98.9	0.4	0.7
395	From Geo. B. Haskell Co., Lewiston, March 24, 1904..... *Number of foreign seeds in 1 pound.* Timothy, 23,975; peppergrass, 200: pigweed, 350.	99.4	0.4	0.2
306	From Shaw, Hammond & Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in 1 pound.* Timothy, 13,800; five-finger, 25,900; unidentified, 3,100.	82.5	10.	7.5

Analysis of seeds from correspondents—Concluded:

Sample number.	Description of Sample, Foreign Seeds, etc.	Pure seed.	Inert matter.	Foreign seeds.
	RED TOP—Continued.	Per ct.	Per ct.	Per ct.
311	From Shaw, Hammond and Carney, Portland, Dec. 13, 1901 *Number of foreign seeds in* 1 *pound.* Timothy, 1,100; white clover, 300; unidentified, 700.	92.1	1.5	.4
347	From H. B. Whipple, Bingham, April 23, 1902............ *Number of foreign seeds in* 1 *pound.* Timothy, 2,000.	98.7	1.2	0.1
353	From H. B. Whipple, Bingham, February 11, 1903........ Mechanical impurities only.	99.5	.5	0
	LAWN SEED.			
410	From Geo. B. Haskell Co., Lewiston, May 6, 1905........ *Number of foreign seeds in* 1 *pound.* Amount of timothy too great to count; five-finger, 600; sheep sorrel, 600; Rugel's plantain, 400; tall dock, 800; unidentified, 1,200.	66.9	8.2	24.9
	CRAB GRASS (*Panicum sanguinale*).			
	From ———— .... *Number of foreign seeds in* 1 *pound.* White clover, 150,600; timothy, 137,800; green foxtail, 6,600; peppergrass, 1,200; sheep sorrel, 3,200; careless weed, 200; lamb's quarters, 1,400.	77.	6.	17.
	RUTABAGA TURNIP. (*Bressica campestris*).			
321	From Lewis Atwood, Winterport, February 24, 1902 .... Mechanical impurities only.	99.2	0.8	0
	RYE. (*Secale cereale*).			
397	From Herbert W. Clair, Cumberland .... Mechanical impurities only.	99.8	0.2	0

FIELD EXPERIMENTS IN 1905.

CHAS. D. WOODS and J. M. BARTLETT.

The Station had about 40 acres in co-operative field experiments in 1905. The mid-summer was too dry in the northernmost part of the State for satisfactory experiments except with potatoes. The inoculation experiments for legumes were failures because of the poor quality of the cultures used. As Aroostook county was practically free from late potato blight, spraying and dusting experiments for this fungus did not give decisive results. The following experiments are here reported.

CLARK METHOD OF GROWING GRASS FOR HAY.

Mr. Clark of Higganum, Conn., has for several years practiced intense cultivation for the production of hay with marked success. His method has been quite generally published in agricultural papers and this has led to the Station receiving many inquiries from correspondents as to the adaptability of this method to Maine conditions. Because of these inquiries the Station undertook to handle two acres of land as nearly as possible in accordance with Mr. Clark's published directions. A worn piece of grass land on rather heavy clay loam was selected for the purpose and plowed in the summer of 1903. This was harrowed about every fortnight with the Clark double action cutaway harrow. At the time the piece was plowed it was hoped that the frequent harrowing would break down the sod, and fine the soil so that a crop of winter rye could be grown. The turf proved too stubborn, however, and the ground was left

without a covering during the winter. No fertilizer was applied in 1903.

The spring of 1904 was unusually wet and backward so that the first harrowing in 1904 was necessarily delayed until June 3. It was at this time harrowed in two directions with the double action cutaway harrow, and then made level with the Clark smoothing harrow. It was harrowed five times after this before it was seeded.

August 16, there was applied at the rate of 800 pounds per acre a fertilizer made from 500 pounds fine bone tankage, 100 pounds nitrate of soda, 300 pounds acid phosphate and 150 pounds of muriate of potash. The 800 pounds of this mixture carried about 27 pounds nitrogen, 75 pounds available phosphoric acid, 115 pounds total phosphoric acid and 75 pounds potash. The field was then again harrowed with the double action harrow and made true with the smoothing harrow, and seeded with timothy and red top at the rate of 14 quarts of each per acre. The seed was harrowed in with the Clark smoothing harrow (without the leveling board) and then rolled. There was an excellent catch and when the snow came the last of November the field was in good shape for the winter.

The following spring (1905) there were applied 300 pounds per acre of a fertilizer carrying about 20 pounds of nitrogen, 8 pounds available phosphoric acid, 22 pounds total phosphoric acid and 50 pounds potash.

As soon as the grass made much growth it was apparent that the piece was overseeded and the grass plants were badly crowding each other. As the result the grass was much finer than timothy and red top usually are. There was such a tangle of fine grasses at the bottom that it could not be cut clean with the mowing machine.

The field was mown the second week in July, at which time the timothy was a little past full bloom. The somewhat less than two acres yielded 6¼ tons of field cured hay. The second growth was not sufficient to warrant cutting. In our experience it is not practicable in the short season of growth to obtain two cuttings of the ordinary grasses. Clover can usually be depended upon to give two cuttings, but unless the first crop is cut too early for the best hay, timothy will give only one cutting a season in central and northern Maine.

The experiment clearly indicates the value of thorough preparation of the seed bed and liberal application of fertilizer for the production of grass. If half the quantity of seed had been used, the yield would probably have been greater and the hay of more desirable quality for horses.

The fertilizers used in growing this crop of 6 tons of hay cost about $40, and the seed and labor of preparation, seeding and harvesting cost about $37. In the next season and succeeding seasons the cost of fertilizers recommended by Mr. Clark and harvesting would be about $25 a year. If three successive crops equal to the first were obtained, the 18 tons of hay would be grown at a cost of a little more than $125. The hay would be worth according to the location of the farm in Maine from $8 to $12 a ton in the barn, or at an average price would bring about $180—a profit of $55 to pay the interest on the capital invested and taxes. With thinner seeding probably a larger crop would have been obtained. If the four tons per acre that Mr. Clark expects from the first cutting were obtained, the profits would be materially increased. It is to be noted that a very considerable part of the profit that Mr. Clark figures comes from the second crop that he can obtain in Connecticut with the 6 weeks longer growing season.

Although it is probable that thorough preparation and fertilization of the soil for hay will in the long run prove profitable even in Maine with its distance from markets, growing grass for the purpose of selling hay is probably not the best kind of agriculture for the average farmer in this State. In a few localities near to the larger cities hay farming may prove a profitable industry.

While thoroughly endorsing the general proposition that thorough preparation and high manuring of the land is essential to the highest success in grass raising, the Station does not recommend the adoption of the Clark method by Maine farmers, chiefly because it does not fit in with mixed farming and rotation of crops. The coarse products of the farm should be fed upon the farm and the manure returned to the land in order to maintain and increase fertility. Selling hay is selling fertility from the farm. Three tons of timothy and red top remove * about 69 pounds of nitrogen, 27 pounds of phosphoric acid and

* Bulletin 107 of this Station, p. 137.

58 pounds potash that it will cost more than $18 to replace commercially.

The plan of a hay farm does not admit of rotation of crops. Rotations are very important in the proper and economical handling of land. For instance, if potatoes or corn are grown preceding grass, the land will be in equally good condition from fall plowing and once harrowing in the spring as from the frequent harrowings necessitated by summer seeding. In the rotation most of the cost of the preparation of the seed bed falls upon a money crop as potatoes, or corn, and not upon the next season's grass crop.

The seeding formula recommended by Mr. Clark does not contain clover. This is the most important forage plant that the Maine farmer can grow. It is rich in protein and is able to obtain its nitrogen from the air. While clover hay does not command as good price as that from red top and timothy, it can be grown at a less cost per ton and has a greater feeding value.

Soil Inoculation for Legumes from Artificial Cultures by the Help of Bacteria.

That legumes such as peas, clover, etc., can by the help of bacteria acquire atmospheric nitrogen through their roots has been a matter of common knowledge for 20 years. The bacteria produce enlargements upon the roots of the plants, which are called root nodules. Not all soils carry the proper organisms, but those deficient can be artificially inoculated. About ten years ago, under the name of Nitragin, commercial cultures were prepared in Germany for the purpose of inoculating sterile soils. This matter is discussed in considerable detail, together with certain experiments with nitragin, in the reports of this Station for 1897, 1898 and 1900. As a scientific curiosity nitragin was of great interest, but in practice it oftener failed to yield satisfactory results than to give them. The principles underlying the use of nitragin are of great practical importance, and many investigators are at work upon the problem. It was announced in an almost sensational article in the Century Magazine for October, 1904, that the U. S. Department of Agriculture had solved the problem of preparing active cultures in a convenient form for distribution. Later the department issued a bulletin *

* Bul. 71, Bureau of Plant Industry, U. S. Dept. Agr.

announcing this discovery and giving the results of a large number of co-operative experiments which seemed to confirm the great claims made for these cultures. Because the soil in New England, where peas and clover have been grown for generations, is very generally inoculated with the nodule forming bacteria, the Station cautioned farmers against the purchase of cultures other than in an experimental way. It seems now that the method itself is unsatisfactory.

Cultures for ordinary legumes were obtained by this Station from the Department at Washington and from the Nitro-Culture Company of West Chester, Pa. The cultures furnished by the company were given to us and we have no reason to think but that they acted in entire good faith and that they believed the method and the cultures they were sending out to be all that was claimed for them. Experiments were carried out by this Station in the summer of 1905 on quite a number of farms in different parts of the State with peas, clover and alfalfa. The results were negative, and because as stated below the failures were due to the culture, the results are not given in detail. While taken by themselves they would not be sufficient to offset the large number of favorable reports printed by the department in the bulletin above cited, they accord with those obtained by many practical men in New England. Why they failed is explained by a very full and careful study made by the New York State Station * in which it is not only shown that the cultures sent out by the department and the commercial companies in 1905 were, so far as examined, worthless, but their studies discredit the method used in the manufacture of the cultures. Their conclusions are summarized as follows:

"I. During the past two years much interest has been shown in the inoculation of legumes with bacteria to enable the legumes to obtain nitrogen from the air.

II. These bacteria have been distributed in a dried condition upon cotton. Before being applied to the seeds the cotton is put into a solution of chemicals and the bacteria allowed to multiply.

III. These packages of treated cotton have had a wide sale at a high price—two dollars for a package sufficient to treat an acre—while the cost of production was less than ten cents.

* Bul. 270, N. Y. State Expt. Sta.

IV. This bulletin gives the results of a bacteriological examination of 18 such packages of cotton.

V. These examinations made it very evident that the packages were worthless for practical purposes.

VI. Substantially identical results upon six of these packages were obtained in five separate laboratories.

VII. It was shown that the failure of these cultures was inherent in the method of their preparation rather than in any knavery of their producers.

VII. While these results will explain the many failures from the use of cotton cultures they should not be undestood as being opposed to the idea of treating the seed of legumes with living bacteria." *

The principle of soil inoculation from cultures is all right, but the method of preparation and shipment practiced by the department and the commercial companies cannot be depended upon. Fortunately for Maine farmers there is probably but little to be gained by inoculating soil for our common leguminous crops such as clover, peas and beans. If one desires to grow alfalfa, soy beans, cow peas, or other leguminous plants that are not usually grown in the State, the inoculation by the application of soil from a field that has grown the desired legume with an abundance of root tubercles is the only sure way yet devised. This inoculation, by the transfer of soil carrying the organism, has never given negative results so far as the writers know. While it is to be hoped that the difficulties that made nitragin a failure, and the equally unsatisfactory results from nitro-cultures may be speedily overcome, the commercial cultures now in the market and any that are likely to be offered in 1906 are apparently valueless for practical purposes.

Fertilizer Experiment in Field Culture of Garden Peas.

In Northern Maine where potatoes are the chief money crop, a common rotation is to follow the potatoes with clover and mixed grasses, seeding with grain, sometimes wheat, but more commonly oats. In Woodland, near Caribou, in the northern part of Aroostook county, a pea canning industry has been introduced by Geo. T. Goodwin and Company. The peas can be used in the rotation in the place of grain. The culture is very

* Bul. 270, N. Y. State Expt. Sta.

simple. The land is plowed in the late fall or early spring, and is treated the same as if grain is to be sown. The peas are planted with a grain drill, clover and mixed grasses if desired being sown at the same time. When the peas are in the right condition for canning, they are cut with a mowing machine and drawn to the factory where they are threshed, shelled and sorted by machinery. The yield in good seasons is about 2,500 pounds of shelled peas per acre, although 3,000 pounds is not an uncommon yield.

In 1905 the Station conducted two experiments on Mr. Goodwin's farms. While these were primarily intended as experiments upon inoculation of peas with artificial cultures, they served at the same time as partial fertilizer experiments. The account of the failure of the inoculation experiments due to the poor quality of the cultures both from the U. S. Department of Agriculture and the Nitro-Culture Company is given on page 28 and following. The report of the fertilizer experiments follows.

In growing potatoes only high grade fertilizers carrying 3 to 4 per cent of nitrogen are employed. Because of the readiness with which this class of fertilizers are obtained they are also quite commonly used for pea growing. When the soil is stocked with the proper organisms, peas, as other legumes, can obtain all, or practically all of their nitrogen from the free nitrogen of the air. The bacteria which enable the plants to do this are more active when the supply of combined nitrogen is limited. Thus it happens that when a fertilizer that furnishes all the nitrogen needed for a given crop of legumes is used, the plants avail themselves of this ready combined nitrogen and do not obtain any considerable amount from the air. In the experiments here reported fertilizers low in nitrogen were used.

EXPERIMENT AT HOME FARM.

The field used for this experiment was situated on a rather moist side hill with a slope to the south. The land was in a good state of cultivation and the greater part of it was planted to peas in 1904, while the rest was in grass. A section of four acres which appeared to be uniform in condition was selected for the experiment and divided into plots of one acre each. The division was so made that each plot covered an equal portion of the section which was in grass last season. The whole field

received a dressing of pea vines from the factory which were plowed under, also the following amounts of fertilizing materials were added to each plot.

Plot 1—400 tbs. acid phosphate, 250 tbs. muriate of potash.

Plots 2, 3, and 4—100 tbs. dried blood, 400 tbs. acid phosphate, 250 tbs. muriate of potash.

On May 23rd Alaska peas were planted with a grain drill at the rate of 2½ bushels to the acre. Those put on plot 1 were inoculated with the Nitro-Culture Company's culture, and those on plot 2 received no treatment. The seed used on plot 3 was treated with the U. S. Department of Agriculture's culture and that of plot 4 was not treated with any culture.

The field was visited June 27 and at that time the peas were about 8 inches high, of good color and appeared to be in a thrifty condition. The roots of some plants on each plot were examined and in every instance the nitrogen collecting bacteria nodules were found to be present. This shows, as was to be expected, that the field was thoroughly stocked with the nodule forming bacteria. There was no noticeable difference in the different plots either in size and thriftiness or in the number or character of the root nodules.

The field was visited again July 28th, but the weeds had then made such progress that it was not possible to make any comparisons of the different plots and the peas were nearly ripe enough to harvest.

On July 29 a part of plot No. 1 was harvested and on the 31st the harvesting of this plot was completed together with plots 2 and 3,—three acres per day being about all the factory could take care of. August 1st plot No. 4 was taken to the factory.

The yields of green peas after being threshed and screened are shown in the following table.

Plot 1. Phosphoric acid and potash, 1,747 pounds.

Plot 2. Nitrogen, phosphoric acid and potash, 1,388 pounds.

Plot 3. Nitrogen, phosphoric acid and potash, 1,307 pounds.

Plot 4. Nitrogen, phosphoric acid and potash, 1,431 pounds.

All of the yields are small, not much more than two-thirds of a crop being secured on account of the very dry season. The larger yield on plot 1 was probably due to some cause not directly connected with the experiment. It is hardly to be thought that the presence of the small amount of nitrogen used on plots, 2, 3 and 4 could have any relation to the diminished yield. The

results show that this small amount of nitrogen was at least unnecessary.

EXPERIMENT ON SECOND FARM.

The experiment made at this farm was on a piece of land which had been in grass for several years and was in a rather low state of cultivation. It was not known to have ever been planted to peas and for this reason was considered an excellent piece on which to test the effect of the nitro-culture material. Four acres of the field was measured off and divided into plots of one acre each. After the sod was turned over and the land thoroughly harrowed it was dressed with 700 lbs. to the acre of the following mixture: nitrate of soda, 50 lbs.; acid phosphate 400 lbs.; muriate of potash 250 lbs. It will be noticed that a very light application of nitrogen was made, the idea being to apply just enough in the most available form for the immediate use of the plants up to the time when the nitrogen collecting bacteria could begin to work.

On May 25 the field was planted to Alaska peas. The seed used on two of the plots was inoculated and on two of them it was not treated.

The field was visited on June 27th and at this time the peas were about 6 inches high with a very even stand over the whole piece. The plants were rather light colored and no nodules could be found on the roots. On July 7th the field was again visited. The plants were found to be 12 to 15 inches high, in blossom and growing finely. The roots were examined for nodules and all the larger plants were found to be abundantly supplied with them, but very few were found upon the roots of the smaller plants and those that were found were down low on the smaller roots. As far as could be observed at this time the nodules were no more plentiful in the plots that had received the culture than on the blanks.

No rain fell during July and this field suffered greatly from the drouth, resulting in the premature ripening of the peas and a yield of less than half a crop. The experiment would not have been reported except for the interesting fact that root nodules formed abundantly on a large part of the plants on two of the four plots. It happened that one of these plots received inoculated seed and the other did not. The two other plots, one

inoculated and one not, had less root nodules. So far as known peas had never been grown on this or near by land. The organism must have been present in the soil or else upon the seed used.

The results of these two experiments are not satisfactory because of the exceedingly sharp drouth, but they seem to indicate that most soils that have been long cultivated are well stocked with the nodule forming bacteria and that a fertilizer containing only the mineral constituents, or at the most a little added nitrate nitrogen, will supply all the needed plant food for a good crop of peas.

Sal Bordeaux for Potato Blight.

In 1904 * experiments were made with dry Bordeaux mixture as a preventive of late blight that showed the dry Bordeaux to be inferior as fungicide and preventive to the wet Bordeaux mixture when applied as a fine spray. The Dust Sprayer Manufacturing Company of Kansas City, Mo., prepare a fine powder that they have named Sal Bordeaux. It consists of equal parts by weight of exceedingly finely ground copper sulphate and lime. This is applied as a dust and the theory is that as soon as this dust becomes moist, from dew or otherwie, the regular Bordeaux mixture in concentrated form is produced at once upon the foliage.

Five plots of one acre each were used in an experiment on the farm of Mr. John Watson of Houlton in comparing the effect of dusting potato vines with Sal Bordeaux and spraying with regular Bordeaux mixture. The potatoes were all Green Mountain. A high grade fertilizer (Watson's Improved) was used at the rate of 1,250 pounds per acre. The different plots were dusted and sprayed on the same days as follows, July 5, July 15, July 25, (followed by showers), August 2, August 10, and August 22.

The Sal Bordeaux was applied at the rate of 10 pounds, 6 pounds and 3 pounds per acre. It was diluted with lime in each case and until the danger of bugs was over, Paris Green was used at the rate of half a pound per acre. On July 31 all the dusted plots were also sprayed with one pound Paris Green and two pounds of lime per acre, as these plots were pretty badly infested with the potato beetle. Either the dusted poison was not as effective as that applied wet, or the showers following the

* Bul. 112, Maine Agricultural Experiment Station p. 6.

application of July 25 washed off the dusted more than it did the sprayed. Whatever the explanation, the dusted rows were infested and the sprayed rows were not.

The Sal Bordeaux was applied with a small hand "cyclone" duster, two rows being treated at a time. The nozzle of the machine was so directed that the cloud of dust striking the row nearest passed through it or was carried by the wind to the adjoining row. Of course the nearest row received the more powder and was more thoroughly dusted, but the dust was plainly visible on the second row and some reached rows beyond. With this apparatus one man could dust an acre an hour.

There was no blight on the whole piece and but little blight in the county in 1905, so that the results are not regarded as conclusive. The yields were practically the same on the 5 plots, running from 100 to 102 barrels (275 to 281 bushels) of merchantable potatoes.

It is planned to repeat the experiment in 1906 and to use a power duster devised for potatoes.

Co-operative Experiments With Alfalfa.

The Station began experimenting with alfalfa in 1903, but because of the lateness of sowing, poor preparation of soil, and other unfavorable conditions, that season's sowings gave no decisive results.

EXPERIMENTS BEGUN IN 1904.

The alfalfa seed (9,452, from Turkestan) used in 1904 was furnished by the U. S. Department of Agriculture. "This seed was secured by Mr. E. A. Bessey in the fall of 1902 at Karabulak, 25 miles north of Chimkent, Turkestan. This part of Turkestan is subject to extremely cold weather in winter and great heat in summer and the alfalfa seed raised there is considered to be the best raised in Turkestan. This seed has been treated with the alfalfa tubercles and should be in condition to give the best results."

At Princeton.

About one-half acre was sown May, 1904, on the farm of Mr. J. W. Edgerly, in Princeton. The land sloped so as to afford

good natural surface drainage. The soil was rather light, and unusually deep and yields 25 to 30 bushels of wheat to the acre. The piece was plowed in the fall of 1904, harrowed, smoothed and seeded with Turkestan alfalfa. It was planted in drills 14 inches apart so as to give the plants plenty of room, in the hope that they could be used to grow seed. Two hand seed drills were used. One of the machines was set too close so that only every other row had a good stand. The poorly seeded rows were reseeded in June. The piece was kept free from weeds by the use of the hand wheel hoe and hand work. The piece was cut once in the mid summer of 1904. It went into the winter in good shape, and came through the winter in fine condition. In 1905 this piece presented the same peculiarities found at Houlton and referred to later. In some places it was dark green in color and very vigorous, and at cutting (July 21, 1905) was 3 feet high. In other places the alfalfa plants were short and yellow. Because of the very uneven growth this experiment has been abandoned.

At Houlton.

This experiment includes two and a half acres of land on the farm of Mr. John Watson. The land slopes to the south and east, and yielded over 100 barrels of potatoes to the acre in 1903. Judging from the yeild of potatoes the soil is quite uniformly productive. The whole field was fertilized with a high grade commercial fertilizer. One-half of the field was limed at the rate of one ton per acre, and one-fourth of the field was liberally dressed with hard wood ashes. The four plots were arranged so as to have lime, ashes, and no alkali on each plot. Plots 1 and 2 were seeded in May, 1904, and plots 3 and 4 in August of that year. Plots 1 and 4 were sown broadcast with a Massey seeder; plots 2 and 3 were drilled with a hand seeder in drills 14 inches apart. Plots 3 and 4 were harrowed frequently with a disc harrow up to the time of seeding in August. On the drilled part the weeds were kept down by the use of the hand wheel hoe and hand weeding. On the broadcast plots the weeds were kept down by mowing. Plot 2 was mown in July. The spring sown plots made a good growth, and went into the winter in good condition. Plots 3 and 4 were so late sown that the plants made but little growth before cold weather.

Treatment in 1905. The spring seeded broadcast plot (1) was badly choked with weeds. It is doubtful if many alfalfa plants were winter killed. Because of the weeds, the seeding of 1904 was abandoned and the plot was plowed, summer fallowed with frequent harrowing and it is planned to re-seed in 1906. The spring drilled plot (2) came through the winter without loss. The following notes were taken May 31. The plot presents very marked peculiarities. All over it are occasional plants that are very dark colored and exceedingly vigorous. These vigorous plants are the most numerous on the part treated with ashes; less numerous on that with lime; and quite scattered on the part that had neither lime nor ashes. All over the piece there are plants of sickly appearance, seemingly nitrogen starved. These, of course are most numerous on the plots that have the least of the very vigorous plants. Specimens of both the luxuriant and poor alfalfa were dug and the roots were found to be about equally stocked with root tubercles. At this date, May 31, the best plants were about 16 inches high. The poor were about 6 inches high.

The field was tested in a number of different places with litmus paper and found to be acid. As the ashes were applied with a manure spreader they would be somewhat unevenly distributed, and it might be that the places where the plants were the most vigorous received a more liberal application and that the acid was neutralized in these spots. This explanation would not apply as well to the lime which was applied by hand in finely powdered form, and would not at all explain the presence of clumps of thrifty plants on the part that had no alkali. The alfalfa was cut in July. Because of the drought in July and August the plants made but little growth until September. They went into the winter in good condition.

Plots 3 and 4 (August seeded) did not come through the winter in good shape, and the 1904 seeding was abandoned. The piece was thoroughly harrowed, smoothed and seeded May 31, 1905, with Montana grown alfalfa seed at the rate of 25 pounds per acre. This seed was applied broadcast with the Massey seeder. No fertilizer was applied this year. The eastern part of the piece, rather more than half an acre, was seeded with "scratched seed,"—i. e. seed that had been passed through a machine that scratched the seed coats, with the

thought of thus hastening germination. The remainder of the piece was seeded with unscratched seed. It germinated well, with no noticeable difference between the scratched and the unscratched seed. Because of the very dry July and August the plants made but little growth before cold weather came on.

At Fort Fairfield.

One piece of about half an acre was seeded broadcast on the farm of Mr. Clarence Powers near Maple Grove Station. This had borne potatoes the preceding season and was thought to be a very clean piece of land. It was found however to be so completely stocked with weeds that the alfalfa had very little chance. A few plants struggled through the summer, but the experiment was abandoned.

In co-operation with Dr. F. M. Perry, about one-half acre was sown near the Fort Fairfield station. This was located on the first river terrace, was light soil and naturally well drained. A liberal application of lime and of a high grade fertilizer was made. The piece was planted in drills 14 inches apart and kept free from weeds with a wheel hoe and hand weeding. A good stand was obtained, the plants grew well, were cut in July, made good second growth and went into the winter in good condition. The plants came through the winter in good shape. The stand was good and for the most part the plants were vigorous. The crop was cut in July, 1905. Because of the drouth but little second growth was made and the plants did not go into the winter of 1905-6 in as good condition as the preceding year.

EXPERIMENTS BEGUN IN 1905.

The U. S. Department of Agriculture placed at the disposal of the Station for distribution among experimenters in Maine, 500 pounds of Montana grown alfalfa seed. The following is quoted from a department letter relative to this seed. "This seed contains quite a percentage of hard seeds, i. e. seeds that will not germinate in the ordinary time and we are now considering the advisability of putting all this seed through a seed scratching machine to see if that will not improve its germinating power. * * * The Montana grown seed we propose furnishing you shows 53.5 per cent of sprouts in 3 days; probably a 7 or 8 day test will bring the germination up to 65 or 70.

At the expiration of that time there will undoubtedly be at least 25 per cent of hard seeds. This alfalfa seed has all been inoculated."

Of that sent, 400 pounds was unscratched and 100 pounds scratched. In no case did the experimenters report that there was any perceptible difference in the field germination of the scratched and the unscratched seed.

A note was put into the agricultural papers of the State that we had a limited amount of alfalfa seed that we would send to any Maine farmer applying for it on condition that the cultural instructions would be followed and results reported to the Station. A very large number of requests were received, many more than we had seed for. Seed was sent to the first 80 that applied with the following cultural suggestions.

Alfalfa—Directions for Culture.

Selection of Soil. Good deep mellow corn or potato land is usually a suitable soil for alfalfa. Good drainage is necessary, as the plants are quickly killed by excess of water in the soil or on the surface. Water must not be allowed to stand on a field of alfalfa more than forty-eight hours at a time, for if the ground becomes saturated with water and is allowed to remain so for any considerable length of time the plants will be drowned out and the roots will decay. Neither will alfalfa succeed if rock, stiff clay, or other impervious subsoil lies too near the surface. Although alfalfa requires good drainage, it also requires a fairly constant water supply and is likely to suffer from drouth on deep, sandy soil.

Preparation of the Soil. The seed is best sown in the early spring on land that was fallowed the preceding summer and left bare during the winter. The summer fallowing, if properly done, will eradicate all weed seeds that were near enough to the surface to germinate. It is well-nigh impossible to start alfalfa if the soil is not in fertile condition. The land should be put in excellent tilth and be in good heart before any attempt is made to sow alfalfa.

Sowing the Seed. The seed should be sown in early spring. For production of hay, alfalfa may be sown either broadcast or drilled. If practicable, drill the seed, as weeds can be more readily kept down. If sown broadcast, 20 pounds are used to

the acre. In drills six or seven inches apart, 15 pounds will be sufficient. This seed should not be sown with any nurse-crop, and the seed should not be drilled deeper than an inch or an inch and a half. On moist soils much less than this is better.

Inoculation for Root Tubercles. The Montana grown alfalfa seed sent herewith has been inoculated with the bacteria that produce root tubercles and enable the plant to acquire nitrogen from the air. Hence soil inoculation is not necessary.

Treatment the First Season. Drills should be cultivated frequently enough to keep down weeds until the alfalfa has a good start. *Young alfalfa is unable to compete with weeds.* It is better for the young alfalfa to mow it frequently, setting the cutter bar rather high, the idea being to cut back the young plants, so that they will branch freely. Frequent cutting also discourages weeds. It should not be cut much later than August 15, in order to leave a good winter protection of vines.

Notes Wanted. Kind of soil and previous treatment.

Date of sowing and whether in drills or broadcast.

Notes and appearance during the season.

Dates of cutting.

Length of vines when ground freezes.

The last of October (1905) blanks for reports were sent to the experimenters and replies were received from 61. Of these 61, less than half succeeded in getting a good stand. Choking out by weeds and the damage from drouth were the two most common causes of failure. Twenty-five of the experimenters report the plants as in good condition for the winter. Another season these 25 plots will be looked after and if the results are instructive, either negatively or positively, they will be reported.

NOTES AND INFERENCES.

Alfalfa growing has been tried many times in the State and while there are no alfalfa fields of any considerable size in Maine, there are a few people who have had partial success in growing the crop. At Bath there are alfalfa plants that have been established for more than ten years. The roots of a specimen sent to the Station last May were more than a half inch through at the crown. On the fine fibrous roots there were a few root nodules. A Topsham farmer has been experimenting with alfalfa for six or seven years and in a letter written last

May says: "Although the stand is not perfect by any means, I think I may claim without boasting that today I have the best plot of ¼ acre of alfalfa in Maine." There are other small pieces in Brunswick that are partial successes. Rust which has proven so destructive in Vermont and Northern New York has not been reported in Maine. Weeds are apparently the greatest menace of any one thing to successful alfalfa growing in the State. A representative of the U. S. Department of Agriculture, who has made two trips through New England studying the alfalfa growing, is of the opinion that the dying out of alfalfa may "possibly be from winter killing but more probably by being run out by native grasses."

Unfortunately, as noticed on page 29, the cultures that were sent out last year for inoculating soils proved unreliable and cannot be counted upon for soil inoculation. Any one desiring to experiment with alfalfa will therefore have to grow it without inoculating the soil, or will have to obtain soil from a field where alfalfa has been grown and produced an abundance of root nodules. In order to be of value to Maine agriculture a good stand must be obtained and the stand must be able to continue not one, but several years. The Station does not advise anyone in this State to grow alfalfa at present except in an experimental way. To those who have land that seems to be suited to alfalfa and have the time and patience to thoroughly care for the crop, the Station will gladly lend assistance in any way that it can. That alfalfa would be a valuable addition to our forage crops needs no demonstration. If the difficuties which thus far have prevented its successful culture can be surmounted, it will more than recompense the cost of the many hundreds of trials that have been given this plant in Maine during the past 25 years.

Home Mixed Fertilizers for Potatoes.

There are sold in Maine a large number (about 40) brands of fertilizers that contain the word "potato" in their name. In the case of more than half of these brands there seems to be no reason, other than the attractiveness of the word, to call them potato fertilizers. More than half of them have the composition of general purpose goods, carying about 3 per cent of nitrogen, 8 per cent of phosphoric acid, and 3 per cent of potash. The same formulas could, with equal propriety, be called corn fertili-

4

zers. A few are seriously intended as special formulas for potatoes. These goods carry proportionately more potash and less phosphoric acid. Such brands carry from 3 to 4 per cent nitrogen, about 6 per cent available phosphoric acid and 5, 8 or even 10 or more per cent of potash.

In 1904 experiments with home mixed fertilizers in comparison with standard high grade mixed goods were made on two farms in the town of Houlton and also in Fort Fairfield. The materials were bought at one time and were all mixed at Houlton. The formula was:—Portland Rendering Company's (rescreened) tankage 420 pounds; acid phosphate 400 pounds; cottonseed meal 200 pounds; sulphate of potash 200 pounds; and nitrate of soda 100 pounds. Analysis showed the mixed goods to have the following composition: Water soluble nitrogen 1.37 per cent; availabe nitrogen 2.72 per cent; total nitrogen 4.09 per cent; available phosphoric acid 7.01 per cent; total phosphoric acid 9.87 per cent; and potash 7.61 per cent.

The details of these experiments are given in Bulletin 112 of this Station. With the exception of one field of early planted potatoes the results were all in favor of the commercial brands.

Average yield of merchantable potatoes grown on home mixed fertilizers in 1904 compared with commercial potato fertilizers.

Owner of Farm.	Acres in experiment.	Barrels of Potatoes. Home mixed fertilizer.	Barrels of Potatoes. Commercial fertilizer.
John Watson, Houlton	8	107	120
W. S. Blake, Houlton	8	106	110
C. A. Powers, Fort Fairfield	4	119	119
R. S. Hoyt, Fort Fairfield	6	109	114

This smaller yield was explained as follows: "The tops kept greener in color during the last half of the growing season with the home mixture. September 1, there was a severe frost all over Northern Maine. The late potatoes grown upon the home mixture had greener and more succulent vines than those upon

the standard fertilizers and in consequence were damaged much more by the frost. In fact, the vines of the late planted potatoes on the home mixed goods were practically killed at this time, while the same varieties planted at the same time upon the standard potato fertilizer continued to grow after this frost. As a result, the potatoes were larger and better ripened with these than upon the home mixed plots. For quick maturing, the home mixed goods apparently carried too much slowly available nitrogen and too little available phosphoric acid."

In 1905 three formulas were compared with one commercial potato fertilizer. The formulas used were as follows:

Home mixed formulas used for potatoes in 1905.

Ingredients.	Number of Formula.		
	2	3	3A
	pounds.	pounds.	pounds.
Nitrate of soda	200	100	100
Screened tankage	200	200	200
Dried blood	100	....	....
Acid phosphate	500	300	500
Sulphate of potash	200	200	200

Percentage composition of fertilizer used in 1905.

	Nitrogen.	Phosphoric Acid.		Potash.
		Available.	Total.	
	%	%	%	%
Formula No. 2	4.7	6.7	8.5	8.3
Formula No. 3	3.4	6.8	9.2	12.5
Formula No. 3A	2.7	8.0	10.2	10.0
Watson's Improved	3.0	6.0	7.0	5.0

Arrangement of acre plots, pounds of fertilizer and constituents applied and yield of potatoes.

Number of plot.	Fertilizer Used.		Pounds per Acre in Fertilizer Used.				Yield of Potatoes.	
	Kind.	Amount.	Nitrogen.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.	Merchantable.	Small.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bbls.	Bbls.
1	Watson's Improved	1,600	48	96	112	80	101	5
2	Home mixed 2	1,200	56	80	102	100	88	6
3	Watson's Improved	1,250	37	75	87	62	71	11
4	Home mixed 3	1,000	34	70	92	125	72½	7
5	Watson's Improved	1,250	37	75	87	62	93	5½
6	Home mixed 3 A	1,000	27	80	102	100	83	2½
7	Watson's Improved	1,250	37	75	87	62	87	3
8	Home mixed 2	1,200	56	80	102	100	87	5
9	Watson's Improved	1,250	37	75	87	62	90	4½
10	Home mixed 3	1,000	34	70	92	125	89	4
11	Watson's Improved	1,250	37	75	87	62	99	4
12	Home mixed 3 A	1,000	27	80	102	100	99	4½
13	Watson's Improved	1,250	37	75	87	62	106	5

The irregularities of the yields on the first 4 plots can be explained by the differences in the character of the soil. Comparing the yields on the home mixed plots with the average of the commercial fertilizer plots either side of the home mixed plots the following results are obtained:

Formula No. 2, 87 barrels; Watson's Improved, 87 barrels.

Formula No. 3, 81 barrels; Watson's Improved, 88 barrels.

Formula No. 3A, 91 barrels; Watson's Improved, 96 barrels.

It will be noted that the results on the whole are again lower with home mixed goods than with the commercial fertilizer. The results are not consistent, however, with each other, and no conclusive interpretation of the results are apparent. It is planned to continue the comparisons another season.

THE EFFECT OF THE RATION ON THE VALUE OF THE MANURE.

J. M. Bartlett.

In digestion experiments with steers, where both the feces and the urine were saved, potash and phosphoric acid determinations as well as nitrogen were made in order that the fertilizing value of the manure from the different rations could be compared. It will be noticed that no figures are given in the table on page 46 for the percentages of potash found in the urine. The determinations were made, but owing to a probable error in calculating the results from the dry to the fresh bases, which at this time cannot be corrected, they are omitted. Other experiments show that the potash of the food is practically all given off in the excretions, so the figures given for potash in the urine are obtained by subtracting the potash of the feces from the total amount taken in the food.

Only traces of phosphoric acid were found in the urine. In the first experiment with hay alone, more nitrogen was found in the excretions than was taken in the food. This discrepancy was probably due to insufficient nitrogen in the ration to maintain the animals and they lost flesh, excreting some body nitrogen. Therefore the feces from this ration relatively contains more nitrogen and value higher than they should, for it is evident that the animals could not continue for any length of time to give off more nitrogen than they received.

The results are given in the tables which follow.

The first table on page 46 gives the weights of food eaten and feces and urine excreted for each animal for the five day that the experiment occupied and the second table contains the percentages of fertilizing ingredients in both food and excreta.

The tables on page 47 contain the amount of fertilizing ingredients excreted by each animal and the total amount of fertilizing ingredients in the food, feces and urine, also the percentages excreted.

The total weight of food eaten, and feces and urine excreted by each steer for five days.

	Steer's number.	Hay.	Grain.	Feces.	Urine.
		Grams.	Grams.	Grams.	Grams.
Hay alone	1	18143	....	7159	16964
Hay alone	2	18143	....	7133	17372
Hay and spring wheat bran	1	15875	6804	8786	15784
Hay and spring wheat bran	2	15875	6804	8488	17826
Hay and winter wheat bran	1	15875	6804	8256	11130
Hay and winter wheat bran	2	15875	6804	8256	16919
Hay and cottonseed meal	1	18143	4536	8501	13970
Hay and cottonseed meal	2	18143	4536	8501	16645

Percentage of fertilizing material in the food, feces and urine.

	Nitrogen.		Phosphoric acid.	Potash.
FOOD.	%	%	%	%
Hay	0.79	....	0.33	1.49
Spring wheat bran	2.66	....	3.19	1.79
Winter wheat bran	2.58	....	2.86	1.46
Cottonseed meal	7.48	....	3.10	1.94
FECES AND URINE.	Feces.	Urine.	Feces.	Feces.
Hay alone ... Steer 1	1.34	0.59	0.58	0.59
Hay alone ... Steer 2	1.25	0.59	0.64	0.48
Hay and spring wheat bran ... Steer 1	1.47	0.97	2.83	1.69
Hay and spring wheat bran ... Steer 2	1.51	0.86	2.49	1.17
Hay and winter wheat bran ... Steer 1	1.45	1.16	2.32	1.74
Hay and winter wheat bran ... Steer 2	1.48	0.75	2.26	1.29
Hay and cottonseed ... Steer 1	1.80	1.87	1.94	0.98
Hay and cottonseed ... Steer 2	1.81	1.48	1.57	1.04

Fertilizing elements excreted by each steer for five days.

	Nitrogen.		Phosphoric acid—solid.	Potash.	
	Solid.	Urine.		Solid.	Urine.
	Grams.	Grams.	Grams.	Grams.	Grams.
Hay alone..........Steer 1	95.9	100.1	41.5	42.2	228.1
Hay alone..........Steer 2	89.2	102.5	45.6	34.2	236.1
Hay and spring wheat bran, Steer 1	129.1	153.1	248.6	148.5	209.9
Hay and springwheat bran, Steer 2	128.2	153.3	211.3	99.3	259.1
Hay and winter wheat bran, Steer 1	119.7	129.1	191.5	143.7	192.2
Hay and winter wheat bran, Steer 2	122.2	126.9	186.6	106.5	229.4
Hay and cottonseed meal...Steer 1	153.0	261.3	164.9	83.3	275.0
Hay and cottonseed meal...Steer 2	154.6	246.5	134.1	88.8	269.5

Fertilizing elements in food and the average amount excreted for each experiment. Five days.

	Amount in Food.			Amount Excreted.			Per Cent Excreted.	
	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.	Potash.	Nitrogen.	Phos. acid.
	Gms.	Gms.	Gms.	Gms.	Gms.	Gms.	%	%
Hay alone..........	143.3	59.9	270.3	193.9	43.6	270.3	135.3	71.8
Hay and spring wheat bran..........	306.4	269.6	358.4	276.4	229.2	358.4	89.2	85.3
Hay and winter wheat bran..........	300.9	243.3	335.9	254.0	189.1	335.9	84.4	77.7
Hay and cottonseed meal, 8 to 2	482.6	200.5	358.3	407.7	149.5	358.3	84.7	74.6

In the table that follows there are given the values of the fertilizing constituents of the total excreta in each experiment and of the resulting manure from 100 pounds of each feed, provided both the solid and liquid excreta are saved. In the calculations the values for the same materials assumed for commercial fertilizers in 1904 are used.

The money value of the fertilizing elements excreted for each experiment.

	Nitrogen.	Phosphoric acid.	Potash.	Total value.
	Cents.	Cents.	Cents.	Cents.
Hay alone	5.36	.39	2.98	8.63
Hay and spring wheat bran	10.40	2.03	3.95	16.38
Hay and winter wheat bran	9.52	1.67	3.70	14.89
Hay and cottonseed meal	15.30	1.32	3.95	20.57
100 lbs. hay	13.50	.98	7.45	21.93
100 lbs. spring wheat bran	37.80	11.91	8.93	58.64
100 lbs. winter wheat bran	31.90	8.85	7.27	48.02
100 lbs. cottonseed meal	99.40	9.30	9.60	118.30

The figures given in the above tables furnish results which are instructive and may be of considerable value to the farmer. In feeding animals or buying feeds, one is very likely to consider only the feeding or flesh forming value of the feeds, not taking into consideration their effect on the value of the manure produced. When more manure is needed than can be made and the supply has to be frequently supplemented with commercial fertilizers, the purchase of high priced feeds rich in fertilizing material is oftentimes the most economical on account of the increased value of the manure they make. In the preceding table it will be seen that for every 100 pounds of cottonseed meal fed, about $1.18 worth of fertilizing material was given off in the excreta when everything is saved.

Another important fact can be learned from the table on page 47 which shows the amount of fertilizing elements in both the solid and liquid excrements. It will be noticed that the larger part of the nitrogen, the most expensive element, and potash are given off in the urine, hence the importance of saving all of this most valuable part of the manure. Not only are other elements found in large quantities in the liquid, but they are in much more available form than in the solid.

FERTILIZER INSPECTION.

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J. M. BARTLETT, Chemist in Charge of Fertilizer Analysis.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer, guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

In the tables which follow the discussion there are given the results of the analyses of the manufacturers' samples of licensed brands. The tables include all the brands which have been licensed to February 1, 1906. Dealers are cautioned against handling any brands not given in this list without first writing the Station.

The figures which are given as the percentages of valuable ingredients guaranteed by the manufacturers are the minimum percentages of the guarantee. If, for instance, the guarantee is 2 to 3 per cent of nitrogen, it is evident that the dealer cannot be held to have agreed to furnish more than 2 per cent, and so this percentage is taken as actual guarantee. The figures under the head of "found" are those showing the actual composition of the samples.

The chief use of fertilizers is to supply plant-food. It is good farming to make the most of the natural resources of the soil and of the manures produced on the farm, and to depend upon artificial fertilizers only to furnish what more is needed. It is not good economy to pay high prices for materials which the soil may itself yield, but it is good economy to supply the lacking ones in the cheapest way. The rule in the purchase of costly commercial fertilizers should be to select those that supply, in the best forms and at the lowest cost, the plant-food which the crop needs and the soil fails to furnish.

Plants differ widely with respect to their capacities for gathering their food from soil and air; hence the proper fertilizer in a given case depends upon the crop as well as upon the soil.

The fertility of the soil would remain practically unchanged if all the ingredients removed in the various farm products were restored to the land. This may be accomplished by feeding the crops grown on the farm to animals, carefully saving the manure and returning it to the soil. If it is practicable to pursue a system of stock feeding in which those products of the farm which are comparatively poor in fertilizing constituents are exchanged in the market for feeding stuffs of high fertilizing value, the loss of soil fertility may be reduced to a minimum, or there may be an actual gain in fertility.

Constituents of Fertilizers.*

The only ingredients of plant-food which we ordinarily need to consider in fertilizers are potash, lime, sulphuric acid, phosphoric acid, and nitrogen. The available supply of sulphuric acid and lime is often insufficient; hence one reason for the good effect so often observed from the application of lime, and of plaster, which is a compound of lime and sulphuric acid. The remaining substances, nitrogen, phosphoric acid and potash, are the most important ingredients of our common commercial fertilizers, both because of their scarcity in the soil and their high cost. It is in supplying these that phosphates, bone manures, potash salts, guano, nitrate of soda, and most other commercial fertilizers are chiefly useful.

The term "form" as applied to a fertilizing constituent has reference to its combination or association with other constituents which may be useful, though not necessarily so. The form of the constituent, too, has an important bearing upon its availability, and hence upon its usefulness as plant food. Many materials containing the essential elements are practically worthless as sources of plant food because the form is not right; the plants are unable to extract them from their combinations; they are "unavailable." In many of these materials the forms may be changed by proper treatment, in which case they become valuable not because the element itself is changed, but because it then exists in such form as readily to feed the plant.

Nitrogen is the most expensive of the three essential fertilizing elements. It exists in three different forms, organic nitrogen, ammonia and nitrate.

* Farmers' Bulletin 44 of the U. S. Dept. of Agriculture, "Commercial Fertilizers, Composition and Use," can be had free by applying to your Congressman.

Organic nitrogen exists in combination with others elements either as vegetable or animal matter. All materials containing organic nitrogen are valuable in proportion to their rapidity of decay, because change of form must take place before the nitrogen can serve as food. Organic nitrogen differs in availability not only according to the kind of material which supplies it, but according to the treatment it receives. The nitrogen in the tables of analyses marked "insoluble in water" is organic nitrogen.

Nitrogen as ammonia usually exists in commercial manures in the form of sulphate of ammonia and is more readily available than organic nitrogen. While nitrogen in the form of ammonia is extremely soluble in water, it is not readily removed from the soil by leaching, as it is held by the organic compounds of the soil.

Nitrogen as nitrate exists in commercial products chiefly as nitrate of soda. Nitrogen in this form is directly and immediately available, no further changes being necessary. It is completely soluble in water, and diffuses readily throughout the soil. It differs from the ammonia compounds in forming no insoluble compounds with soil constituents and may be lost by leaching. The "nitrogen soluble in water" of the tables includes both the nitrogen as ammonia and as nitrate.

Phosphoric acid is derived from materials called phosphates, in which it may exist in combination with lime, iron, or alumina as phosphates of lime, iron or alumina. Phosphate of lime is the form most largely used as a source of phosphoric acid. Phosphoric acid occurs in fertilizers in three forms: That soluble in water and readily taken up by plants; that insoluble in water, but still readily used by plants, also known as "reverted;" and that soluble only in strong acids and consequently very slowly used by the plant. The "soluble" and "reverted" together constitute the "available" phosphoric acid. The phosphoric acid in natural or untreated phosphates is insoluble in water, and not readily available to plants. If it is combined with organic substance, as in animal bone, the rate of decay is more rapid than if with purely mineral substances. The insoluble phosphates may be converted into soluble forms by treatment with strong acids. Such products are known as acid phosphates or superphosphates. The "insoluble phosphoric acid" of a high cost commercial fertilizer has little or no value to

the purchaser because at the usual rate of application the quantity is too small to have any perceptible effect upon the crop, and because its presence in the fertilizer excludes an equal amount of more needful and valuable constituents.

Potash in commercial fertilizers exists chiefly as muriates and sulphates. With potash the form does not exert so great an influence upon availability as is the case with nitrogen and phosphoric acid. All forms are freely soluble in water, and are believed to be nearly if not quite equally available as food. The form of the potash has an important influence upon the quality of certain crops. For example, the results of experiments seem to indicate that the quality of tobacco, potatoes, and certain other crops is unfavorably influenced by the use of muriate of potash, while the same crops show a superior quality if materials free from chlorides have been used as the source of potash.

Valuation of Fertilizers.

The agricultural value of any fertilizing constituent is measured by the value of the increase of the crop produced by its use, and is, of course, a variable factor, depending upon the availability of the constituent, and the value of the crop produced. The form of the materials used must be carefully considered in the use of manures. Slow-acting materials cannot be expected to give profitable returns upon quick growing crops, nor expensive materials profitable returns when used for crops of relatively low value.

The agricultural value is distinct from what is termed "commercial value," or cost in market. This value is determined by market and trade conditions, as cost of production of the crude material, methods of manipulation required, etc. Since there is no strict relation between agricultural and commercial or market value, it may happen that an element in its most available form, and under ordinary conditions of high agricultural value, costs less in market than the same element in less available forms and of a lower agricultural value. The commercial value has reference to the material as an article of commerce, hence commercial ratings of various fertilizers have reference to their relative cost and are used largely as a means by which the different materials may be compared.

The commercial valuation of a fertilizer consists in calculating the retail trade-value or cash-cost at freight centers (in raw

material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer. Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates, and similar articles, for which $20 to $45 per ton are paid, depend for their trade value exclusively on the substances, nitrogen, phosphoric acid and potash, which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce. The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the trade-value of the above-named ingredients a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

TRADE VALUES OF FERTILIZING INGREDIENTS.

	Cents per pound
Nitrogen in nitrates	17
in ammonia salts	17½
Organic nitrogen in dry and fine ground fish, meat and blood, and in mixed fertilizers	18½
in fine bone and tankage	18
in coarse bone and tankage	13
Phosphoric acid, water-soluble	4½
citrate-soluble	4
of fine ground bone and tankage	4
of coarse bone and tankage	3
of cotten seed meal, castor pomace, and ashes	4
of mixed fertilizers, if insoluble in ammonium citrate	2
Potash as high grade sulphate and in forms free from muriate (or chlorides)	5
as muriate	4½
as carbonate	8

A rule for calculating the commercial valuation of mixed fertilizers is given on page 64.

The results of the analyses of the manufacturers' samples of fertilizers are given on the pages which follow.

Descriptive List of Manufacturers' Samples, 1906.

Station number.	Manufacturer, place of business and brand.
	AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK, N. Y.
1001	A. A. C. Company, Aroostook Complete Manure
1002	A. A. C. Company, Aroostook High Grade
1003	Bradley's Alkaline Bone with Potash
1004	Bradley's Complete Manure for Potatoes and Vegetables
1005	Bradley's Complete Manure with 10% Potash
1006	Bradley's Corn Phosphate
1007	Bradley's Eureka Fertilizer
1008	Bradley's Niagara Phosphate
1009	Bradley's Potato Fertilizer
1010	Bradley's Potato Manure
1011	X. L. Superphosphate of Lime
1012	Clark's Cove Bay State Fertilizer
1013	Clark's Cove Bay State Fertilizer, G. G
1014	Clark's Cove Bay State Fertilizer for Seeding Down
1015	Clark's Cove Defiance Complete Manure
1016	Clark's Cove Great Planet Manure, A. A
1017	Clark's Cove King Phillips Alkaline Guano
1018	Clark's Cove Potato Fertilizer
1019	Clark's Cove Potato Manure
1020	Cleveland Fertilizer for all Crops
1021	Cleveland High Grade Complete Manure
1022	Cleveland Potato Phosphate
1023	Cleveland Seeding Down Fertilizer
1024	Cleveland Superphosphate
1025	Complete Manure with 10% Potash
1026	Crocker's Aroostook Potato Special
1027	Crocker's Ammoniated Corn Phosphate
1028	Crocker's Grass and Oats Fertilizer
1029	Crocker's High Grade
1030	Crocker's New Rival Ammoniated Superphosphate
1031	Crocker's Potato, Hop and Tobacco
1032	Crocker's Special Potato Manure
1033	Cumberland Guano for all Crops
1034	Cumberland Potato Fertilizer
1035	Cumberland Seeding Down Manure
1036	Cumberland Superphosphate
1037	Darling's Blood, Bone and Potash
1038	Fine Ground Bone
1039	Grass and Lawn Top Dressing
1040	Great Eastern General
1041	Great Eastern Grass and Oats Fertilizer
1042	Great Eastern High Grade Potato Manure
1043	Great Eastern Northern Corn Special
1044	Great Eastern Potato Manure
1045	Great Eastern Potato Special

Analyses of Manufacturers' Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1001	1.01	1.40	2.41	2.47	3.08	3.20	2.00	6.28	6.00	8.28	......	10.04	10.00
1002	2.88	1.62	4.50	4.12	4.31	2.21	2.83	6.52	7.00	9.35	......	7.60	7.00
1003	......	......	......	......	5.34	4.18	3.64	9.52	11.00	13.16	12.00	2.49	2.00
1004	2.57	1.37	3.94	3.30	5.49	2.08	2.72	7.57	8.00	10.29	9.00	6.52	7.00
1005	1.99	1.31	3.30	3.30	3.59	3.19	2.44	6.78	6.00	9.22	7.00	11.20	10.00
1006	0.66	1.42	2.08	2.06	7.05	2.55	2.56	9.60	8.00	11.16	10.00	2.01	1.50
1007	0.11	1.06	1.17	1.03	5.93	2.35	1.55	8.28	8.00	9.83	10.00	2.32	2.00
1008	0.40	0.64	1.04	0.82	5.41	3.15	1.38	8.56	7.00	9.94	8.00	1.49	1.00
1009	1.64	0.62	2.26	2.06	5.85	1.89	2.67	7.74	8.00	10.41	10.00	3.13	3.00
1010	1.29	1.44	2.73	2.50	5.42	0.79	2.48	6.21	6.00	8.69	8.00	4.96	5.00
1011	1.45	1.13	2.58	2.50	6.62	2.54	3.25	9.16	9.00	12.41	11.00	2.34	2.00
1012	1.45	1.07	2.52	2.50	6.67	2.39	3.59	9.06	9.00	12.65	11.00	2.34	2.00
1013	1.58	0.74	2.32	2.06	5.42	2.39	3.32	7.81	8.00	11.13	10.00	1.85	1.50
1014	0.41	0.74	1.45	1.03	5.93	2.80	2.42	8.73	8.00	11.15	10.00	2.57	2.00
1015	0.40	0.68	1.08	0.82	5.24	2.74	1.48	7.98	7.00	9.46	8.00	1.59	1.00
1016	1.88	1.52	3.40	3.30	5.20	3.01	1.96	8.21	8.00	10.17	9.00	7.43	7.00
1017	0.43	0.68	1.11	1.03	5.71	2.67	1.47	8.38	8.00	9.85	10.00	2.12	2.00
1018	1.76	0.56	2.32	2.06	5.92	1.98	2.74	7.90	8.00	10.64	10.00	3.30	3.00
1019	0.56	2.11	2.67	2.50	3.96	3.03	3.49	6.99	6.00	10.48	8.00	5.59	5.00
1020	0.34	0.72	1.06	1.03	5.50	2.87	2.60	8.37	8.00	10.97	10.00	2.30	2.00
1021	2.32	1.33	3.65	3.30	5.63	2.11	2.69	7.74	8.00	10.43	9.00	6.74	7.00
1022	1.63	0.56	2.19	2.06	6.06	1.74	2.73	7.80	8.00	10.53	10.00	3.17	3.00
1023	0.11	1.06	1.17	1.03	5.79	2.89	1.27	8.68	8.00	9.95	10.00	2.20	2.00
1024	0.66	1.40	2.06	2.06	7.17	2.35	2.62	9.52	8.00	12.14	10.00	2.03	1.50
1025	1.99	1.46	3.45	3.30	4.31	1.95	2.07	6.26	6.00	8.33	7.00	9.55	10.00
1026	0.81	1.29	2.10	2.06	5.17	3.33	2.03	8.50	8.00	10.53	......	6.61	6.00
1027	0.26	2.06	2.32	2.06	4.52	3.65	3.87	8.17	8.00	12.04	......	2.26	1.50
1028	......	......	......	......	7.54	4.28	1.79	11.82	11.00	13.61	......	2.03	2.00
1029	1.79	1.52	3.31	3.29	5.87	2.41	2.50	8.28	8.00	10.78	......	7.41	7.00
1030	0.23	1.14	1.37	1.03	4.82	3.70	2.47	8.52	8.00	10.99	......	2.12	2.00
1031	1.10	1.10	2.20	2.06	5.98	2.07	2.68	8.05	8.00	10.73	......	3.34	3.00
1032	2.01	1.30	3.31	3.29	3.84	3.29	2.34	7.13	6.00	9.47	......	10.80	10.00
1033	0.03	1.23	1.26	1.03	6.22	3.00	2.49	9.22	8.00	11.71	10.00	2.28	2.00
1034	0.72	1.34	2.06	2.06	6.13	4.17	2.33	10.30	8.00	12.63	10.00	3.38	3.00
1035	0.44	0.72	1.16	1.03	5.42	2.98	2.53	8.40	8.00	10.93	10.00	2.53	2.00
1036	1.64	0.74	2.38	2.06	5.30	2.56	3.18	7.86	8.00	11.04	10.00	1.89	1.50
1037	2.76	1.40	4.16	4.10	4.98	1.90	2.48	6.88	7.00	9.36	8.00	7.16	7.00
1038	......	......	2.50	2.47	......	......	......	......	......	25.31	22.80	......	......
1039	4.44	0.08	4.52	3.91	1.03	5.16	0.97	7.69	5.00	8.66	6.00	3.56	2.00
1040	0.52	0.96	1.48	0.82	5.17	2.42	3.05	7.59	8.00	10.64	......	4.73	4.00
1041	......	......	......	......	4.11	6.88	4.08	10.99	11.00	15.07	......	2.15	2.00
1042	2.38	1.00	3.38	3.29	4.87	3.25	1.86	8.12	6.00	9.98	......	10.64	10.00
1043	0.42	1.84	2.26	2.06	5.02	4.60	2.35	9.62	8.00	11.98	......	2.26	1.50
1044	0.85	1.23	2.08	2.06	5.92	2.31	2.76	8.23	8.00	10.99	......	3.37	3.00
1045	1.68	1.62	3.30	3.29	5.87	2.27	2.56	8.14	8.00	10.70	......	7.57	7.00

Descriptive List of Manufacturers' Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1046	High Grade Fertilizer with 10% Potash
1047	High Grade Sulphate of Potash
1048	Lazaretto Aroostook Potato Guano
1049	Lazaretto Corn Guano
1050	Lazaretto High Grade Potato Manure
1051	Lazaretto Propeller Potato Guano
1052	Lazaretto Special Potato Manure
1053	Muriate of Potash
1054	Nitrate of Soda
1055	Otis' Potato Fertilizer
1056	Otis' Seeding Down Fertilizer
1057	Otis' Superphosphate
1058	Pacific Dissolved Bone and Potash
1059	Pacific Grass and Grain Fertilizer
1060	Pacific High Grade General Fertilizer
1061	Pacific Nobesque Guano
1062	Pacific Potato Special
1063	Packer's Union Animal Corn Fertilizer
1064	Packer's Union Economical Vegetable Guano
1065	Packer's Union Gardiner's Complete Manure
1066	Packer's Union High Grade
1067	Packer's Union Potato Manure
1068	Packer's Union Universal Fertilizer
1069	Packer's Union Wheat, Oats and Clover Fertilizer
1070	Plain Superphosphate
1071	Quinnipiac Climax Phosphate for all Crops
1072	Quinnipiac Corn Manure
1073	Quinnipiac Market Garden Manure
1074	Quinnipiac Mohawk Fertilizer
1075	Quinnipiac Potato Manure
1076	Quinnipiac Potato Phosphate
1077	Read's Farmers' Friend
1078	Read's High Grade Farmers' Friend
1079	Read's Potato Manure
1080	Read's Practical Potato Special
1081	Read's Standard Superphosphate
1082	Read's Sure Catch Fertilizer
1083	Read's Vegetable and Vine Fertilizer
1084	Soluble Pacific Guano
1085	Standard A Brand
1086	Standard Bone and Potash
1087	Standard Complete Manure
1088	Standard Fertilizer
1089	Standard Guano for all Crops
1090	Standard Special for Potatoes
1091	Williams and Clark's Americus Ammoniated Bone Superphosphate
1092	Williams and Clark's Americus Corn Phosphate
1093	Williams and Clark's Americus High Grade Special

Analyses of Manufacturers' Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
1046	1.50	1.03	2.53	2.40	5.82	1.76	2.63	7.58	6.00	10.21	7.00	10.44	10.00
1047	......	......	......	......	......	......	......	......	......	......	......	49.80	48.00
1048	0.19	0.78	0.97	0.82	5.69	3.36	2.11	9.05	8.00	11.16	......	4.57	4.00
1049	0.95	1.02	1.97	1.64	4.47	3.20	2.74	7.67	8.00	10.41	......	2.53	2.00
1050	1.21	1.82	3.03	3.29	4.00	1.90	2.27	5.90	6.00	8.17	......	10.60	10.00
1051	0.70	1.30	2.00	2.06	5.69	2.56	2.88	8.25	8.00	11.13	......	6.52	6.00
1052	1.69	1.56	3.25	3.29	5.85	2.27	2.55	8.12	8.00	10.67	......	7.70	7.00
1053	......	......	......	......	......	......	......	......	......	......	......	49.63	50.00
1054	15.12	......	15.12	15.80	......	......	......	......	......	......	......	......	......
1055	1.74	0.58	2.32	2.06	5.74	2.28	2.46	8.02	8.00	10.48	10.00	3.05	3.00
1056	0.37	0.78	1.15	1.03	5.95	2.03	2.83	7.98	8.00	10.81	10.00	2.01	2.00
1057	0.68	1.38	2.06	2.06	6.94	2.92	2.43	9.86	8.00	12.29	10.00	2.16	1.50
1058	......	......	......	......	5.98	4.81	1.91	10.79	10.00	12.70	11.00	2.43	2.00
1059	0.42	0.64	1.06	0.82	5.46	3.01	1.43	8.47	7.00	9.90	8.00	2.99	1.00
1060	2.13	1.41	3.54	3.30	5.15	2.92	2.14	8.07	8.00	10.21	9.00	7.18	7.00
1061	0.45	0.80	1.25	1.03	5.53	2.31	2.73	7.84	8.00	10.57	10.00	2.14	2.00
1062	0.76	1.34	2.10	2.06	5.69	4.27	2.70	9.96	8.00	12.66	10.00	3.15	3.00
1063	0.31	2.10	2.41	2.47	5.64	3.22	3.46	8.86	9.00	12.32	......	1.91	2.00
1064	0.26	1.47	1.68	1.25	4.65	2.55	2.15	7.20	6.00	9.35	......	3.59	3.00
1065	1.38	1.16	2.54	2.47	5.58	0.47	2.06	6.05	6.00	8.11	......	10.99	10.00
1066	1.75	1.56	3.31	3.29	5.85	2.41	2.55	8.26	8.00	10.81	......	7.53	7.00
1067	0.96	1.10	2.06	2.06	4.85	3.16	1.85	8.01	8.00	9.86	......	6.54	6.00
1068	0.25	0.96	1.21	0.82	6.05	3.22	1.46	9.27	8.00	10.73	......	5.04	4.00
1069	......	......	......	......	......	......	1.20	10.92	11.00	12.12	......	2.39	2.00
1070	......	......	......	......	10.21	3.91	1.30	14.12	14.00	15.42	15.00	......	......
1071	0.39	1.06	1.45	1.03	5.10	3.54	1.63	8.64	8.00	10.27	10.00	2.91	2.00
1072	0.67	1.38	2.05	2.06	6.69	2.63	2.41	9.32	8.00	11.73	10.00	1.95	1.50
1073	2.19	1.38	3.58	3.30	4.23	4.67	1.47	8.90	8.00	10.37	9.00	7.57	7.00
1074	0.03	0.83	0.86	0.82	2.60	4.87	3.86	7.47	7.00	11.33	8.00	1.58	1.00
1075	1.03	1.50	2.53	2.50	2.55	4.03	3.06	6.58	6.00	9.64	8.00	5.15	5.00
1076	0.74	1.30	2.04	2.06	5.61	4.71	2.36	10.32	8.00	12.68	10.00	3.34	3.00
1077	1.57	0.62	2.19	2.06	5.84	2.08	2.59	7.92	8.00	10.51	10.00	3.11	3.00
1078	2.23	1.48	3.71	3.30	3.96	2.13	2.08	6.09	6.00	8.17	7.00	9.59	10.00
1079	0.42	2.28	2.70	2.40	4.59	1.89	1.25	6.48	6.00	7.73	7.00	10.94	10.00
1080	0.42	0.74	1.16	0.82	1.64	2.56	1.99	4.20	4.00	6.19	5.00	8.03	8.00
1081	0.10	0.94	1.04	0.82	5.87	2.89	2.23	8.76	8.00	10.99	10.00	4.81	4.00
1082	......	......	......	......	5.42	3.90	3.09	9.32	10.00	12.41	11.00	2.59	2.00
1083	0.32	1.80	2.12	2.06	5.94	2.25	1.38	8.29	8.00	9.67	10.00	6.35	6.00
1084	1.58	0.80	2.38	2.06	5.18	2.81	3.01	8.09	8.00	11.10	10.00	1.89	1.50
1085	0.31	0.90	1.21	0.82	3.64	4.10	2.08	7.74	7.00	9.82	8.00	1.56	1.00
1086	......	......	......	......	7.66	2.60	1.96	10.26	10.00	12.22	11.00	2.08	2.00
1087	2.40	0.90	3.30	3.30	7.02	1.99	1.04	8.81	8.00	9.85	9.00	7.56	7.00
1088	1.60	0.78	2.38	2.06	5.14	2.41	3.36	7.55	8.00	10.91	10.00	1.70	1.50
1089	0.37	0.70	1.07	1.03	5.31	3.03	1.44	8.34	8.00	9.74	10.00	2.10	2.00
1090	1.68	0.62	2.30	2.06	5.82	2.22	2.45	8.04	8.00	10.49	10.00	3.17	3.00
1091	1.40	1.35	2.75	2.50	5.52	2.65	3.44	8.17	9.00	11.61	11.00	2.78	2.00
1092	1.35	0.76	2.11	2.06	5.58	2.78	3.04	8.36	8.00	11.40	10.00	1.99	1.50
1093	2.36	1.33	3.69	3.30	5.57	2.56	2.48	8.13	8.00	10.61	9.00	6.54	7.00

Descriptive List of Manufacturers' Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1094	Williams and Clark's Americus Potato Manure
1095	Williams and Clark's Royal Bone Phosphate for all Crops
	ARMOUR FERTILIZER WORKS, BALTIMORE, MD.
1096	All Soluble
1097	Bone, Blood and Potash
1098	Grain Grower
1099	High Grade Potato
1100	Wheat, Corn and Oats
	BOWKER FERTILIZER CO., BOSTON, MASS.
1101	Bowker's Bone, Blood and Potash
1102	Bowker's Bone and Potash Square Brand
1103	Bowker's Corn Phosphate
1104	Bowker's Early Potato Manure
1105	Bowker's Farm and Garden Phosphate
1106	Bowker's Fresh Ground Bone
1107	Bowker's Hill and Drill Phosphate
1108	Bowker's Market Garden Phosphate
1109	Bowker's Potash Bone
1110	Bowker's Potash or Staple Phosphate
1111	Bowker's Potato and Vegetable Fertilizer
1112	Bowker's Potato and Vegetable Phosphate
1113	Bowker's Six Per Cent Potato Fertilizer
1114	Bowker's Superphosphate with Potash for Grass and Grain
1115	Bowker's Sure Crop Phosphate
1116	Bowker's Ten Per Cent Manure
1117	Monticello Grange Chemicals
1118	Special Potato Manure for the Grange
1119	Stockbridge Special Manure (for Corn, etc.) Class D 107
1120	Stockbridge Special Manure (for Grass, etc.) Class F 56
1121	Stockbridge Special Manure (for Potatoes, etc.) Class D 610
1122	Stockbridge Special Manure (for Seeding Down, etc.) Class C 610
	COE-MORTIMER CO., NEW YORK, N. Y.
1123	E. Frank Coe's Celebrated Special Potato Fertilizer
1124	E. Frank Coe's Columbian Corn Fertilizer
1125	E. Frank Coe's Columbian Potato Fertilizer
1126	E. Frank Coe's Excelsior Potato Fertilizer
1127	E. Frank Coe's Grass and Grain Special
1128	E. Frank Coe's High Grade Ammoniated Bone Superphosphate
1129	E. Frank Coe's High Grade Potato Fertilizer
1130	E. Frank Coe's New Englander Corn Fertilizer
1131	E. Frank Coe's New Englander Special Potato Fertilizer
1132	E. Frank Coe's Prize Brand Grain and Grass Fertilizer
1133	E. Frank Coe's Red Brand Excelsior Guano
1134	E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate
	HUBBARD FERTILIZER CO., OF BALTIMORE, BALTIMORE, MD.
1137	Hubbard's Bone, Blood and Potash
1138	Hubbard's Royal Ensign
	JOHN WATSON COMPANY, HOULTON, ME.
1141	Watson's Improved High Grade Potato Manure

Analyses of Manufacturers' Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1094	1.68	0.60	2.28	2.06	6.17	2.02	2.48	8.19	8.00	10.67	10.00	3.28	3.00
1095	0.29	0.82	1.11	1.03	5.47	3.14	2.55	8.61	8.00	11.16	10.00	2.59	2.00
1096	1.40	1.80	3.20	2.88	5.61	1.95	1.82	7.56	8.00	9.38	10.00	3.88	4.00
1097	2.34	2.21	4.55	4.11	6.67	1.47	1.01	8.24	8.00	9.25	10.00	8.40	7.00
1098	0.94	0.72	1.66	1.65	5.61	2.35	1.26	7.96	8.00	9.22	10.00	2.51	2.00
1099	0.66	1.31	1.97	1.65	6.97	1.36	1.34	8.33	8.00	9.67	10.00	9.84	10.00
1100	0.22	0.60	0.82	0.82	5.04	2.24	2.02	7.28	7.00	9.30	9.00	1.24	1.00
1101	2.21	1.75	3.36	4.10	3.27	4.83	2.11	8.10	8.00	10.21	10.00	6.77	7.00
1102	1.03	0.81	1.84	1.65	1.04	3.68	7.10	4.72	6.00	11.82	7.00	2.34	2.00
1103	0.40	1.14	1.54	1.65	2.27	5.90	2.19	8.17	8.00	10.36	9.00	2.52	2.00
1104	1.19	1.95	3.14	3.29	3.57	3.49	2.23	7.06	7.00	9.29	8.00	7.33	7.00
1105	0.52	1.16	1.68	1.65	2.20	6.62	2.50	8.92	8.00	11.42	9.00	2.80	2.00
1106	......	......	2.50	2.47	......	......	......	......	......	19.09	18.00	......	......
1107	0.71	1.73	2.44	2.47	3.27	5.48	2.76	8.75	9.00	11.51	10.00	2.16	2.00
1108	1.59	0.79	2.38	2.47	5.55	2.12	1.34	7.67	6.00	9.01	7.00	9.85	10.00
1109	0.90	......	0.90	0.82	3.05	1.93	3.03	4.98	6.00	8.01	7.00	2.10	2.00
1110	0.18	0.74	0.92	0.82	1.69	6.43	2.15	8.12	8.00	10.27	9.00	3.37	3.00
1111	0.61	1.73	2.34	2.47	7.26	2.32	0.83	9.58	8.00	10.41	10.00	4.30	4.00
1112	0.30	1.18	1.48	1.65	2.28	6.79	2.31	9.07	9.00	11.38	10.00	2.32	2.00
1113	0.35	0.65	1.00	0.82	1.39	4.82	3.05	6.21	6.00	9.26	7.00	6.48	6.00
1114	......	......	......	......	4.39	5.30	1.71	9.69	10.00	11.40	11.00	2.84	2.00
1115	0.35	0.72	1.07	0.82	4.93	3.50	2.42	8.43	9.00	10.88	10.00	2.37	2.00
1116	0.17	0.69	0.86	0.82	1.29	3.92	1.99	5.21	5.00	7.20	6.00	10.34	10.00
1117	1.15	1.09	2.24	2.50	5.34	2.80	1.67	8.14	8.00	9.81	12.00	4.17	4.00
*1118	.....	......	......	1.50	......	......	......	......	9.00	......	12.00	......	12.00
1119	1.93	1.40	3.33	3.29	7.89	2.30	0.91	10.19	10.00	11.10	11.00	7.39	7.00
1120	3.18	1.88	5.06	4.94	3.01	2.69	2.26	5.70	4.00	7.96	6.00	6.11	6.00
1121	1.32	1.88	3.20	3.29	2.57	3.54	2.27	6.11	6.00	8.38	7.00	10.34	10.00
1122	0.79	1.59	2.38	2.47	2.97	2.88	4.24	5.85	6.00	10.09	9.00	10.04	10.00
1123	1.26	0.62	1.88	1.65	7.34	1.19	2.71	8.53	8.00	11.24	10.00	4.73	4.00
1124	0.60	0.74	1.34	1.23	7.29	2.77	2.53	9.46	8.50	12.01	10.50	2.98	2.50
1125	0.54	0.80	1.34	1.23	6.30	2.16	2.49	9.46	8.50	11.95	10.50	3.08	2.50
1126	1.46	0.96	2.41	2.47	6 03	1.97	2.22	8.00	7.00	10.22	9.00	9.35	8.00
1127	0.07	0.73	0.80	0.80	6.73	2.57	2.81	9.30	8.50	12.11	......	2.28	1.50
1128	1.02	1.06	2.08	1.85	6.76	2.26	2.30	9.02	9.00	11.32	11.00	3.09	2.25
1129	1.68	0.92	2.60	2.40	7.15	1.53	2.76	8.68	8.00	11.44	10.00	6.48	6.00
1130	0.63	0.70	1.33	0.80	7.15	2.42	2.60	9.57	7.50	12.17	9.00	3.11	3.00
1131	0.37	0.66	1.03	0.80	6.09	2.36	2.78	8.45	7.50	11.23	9.00	3.28	3.00
1132	......	......	......	......	6.64	3.96	3.06	10.55	10.50	13.61	12.00	2.59	2.00
1133	2.30	1.07	3.37	3.30	7.59	2.14	1.77	9.73	9.00	11.50	10.00	6.74	6.00
1134	0.63	0.56	1.19	1.20	6.03	2.50	2.70	8.53	8.50	11.23	10.00	3.90	2.00
1137	1.60	2.12	3.72	3.29	9.14	0.48	0.76	9.62	8.00	10.38	9.00	9.09	7.00
1138	1.58	1.36	2.94	2.47	8.80	1.08	0.55	9.88	8.00	10.43	9.00	4.55	4.00
1141	1.74	1.27	3.01	3.00	4.29	2.12	4.02	6.41	6.00	10.43	7.00	5.25	5.00

* Sample received too late for analysis.

Descriptive List of Manufacturers' Samples, 1906.

Station number.	Manufacturer, place of business and brand.
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
1142	Lister's Animal Bone and Potash
1143	Lister's Bone Meal
1144	Lister's High Grade Special for Spring Crops
1145	Lister's Oneida Special
1146	Lister's Potato Manure
1147	Lister's Special Corn Fertilizer
1148	Lister's Special Potato Fertilizer
1149	Lister's Success Fertilizer
1150	Lister's 10% Potato Grower
	NATIONAL FERTILIZER CO., BRIDGEPORT, CONN.
1151	Chittenden's Complete Root
1152	Chittenden's Excelsior Potato Fertilizer
1153	Chittenden's Eureka Potato Fertilizer
1154	Chittenden's Market Garden
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.
1155	New England Complete Manure
1156	New England Corn and Grain Fertilizer
1157	New England Corn Phosphate
1158	New England High Grade Potato Fertilizer
1159	New England High Grade Special with 10 Per Cent Potash
1160	New England Potato Fertilizer
1161	New England Potato Grower
1162	New England Market Garden Manure
1163	New England Superphosphate
	OLDS & WHIPPLE, HARTFORD, CONN.
1164	"Excelsior" Potato Fertilizer
	PARMENTER & POLSLEY FERTILIZER CO., PEABODY, MASS.
1166	A. A. Brand
1167	Aroostook Special
1168	Ground Bone
1169	Muriate of Potash
1170	Nitrate of Soda
1171	P. & P. Grain Grower
1172	P. & P. Potato
1173	Plymouth Rock
1174	Special Potato
1175	Star Brand
	PORTLAND RENDERING CO., PORTLAND, MAINE.
1176	Bone Dust Tankage
	PROVINCIAL CHEMICAL FERTILIZER CO., ST. JOHN, N. B.
1177	Special Potato Phosphate
1178	10% Complete "Aroostook" Potato
	R. T. PRENTISS CO., PRESQUE ISLE, MAINE.
1179	Prentiss Aroostook Complete
1180	Prentiss Aroostook Special
1181	Prentiss Aroostook Standard
	TUSCARORA FERTILIZER CO., BALTIMORE.
1214	Tuscarora Fruit and Potato
	RUSSIA CEMENT CO., GLOUCESTER, MASS.
1182	Essex A1 Superphosphate
1183	Essex Aroostook County Special Potato Manure
1184	Essex Complete Manure for Aroostook County Crops

Analyses of Manufacturers' Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1142	......	......	......	......	6.44	3.84	2.19	10.28	11.00	12.47	12.00	2.26	2.00
*1143	......	......	......	2.68	......	......	......	......	......	......	23.00	......	......
1144	0.45	1.50	1.95	1.65	3.75	4.34	3.07	8.09	8.00	11.16	9.20	11.16	10.00
1145	0.34	0.83	1.17	0.83	4.42	3.71	2.48	8.13	7.00	10.61	8.00	1.16	1.00
1146	1.92	1.25	3.17	3.30	5.50	2.46	3.09	7.96	8.00	11.05	9.00	7.22	7.00
1147	0.70	1.12	1.82	1.65	5.63	3.72	2.39	9.35	8.00	11.74	9.00	3.66	3.00
1148	0.64	1.22	1.86	1.65	5.66	3.94	2.19	9.60	8.00	11.79	9.00	3.52	3.00
1149	0.31	0.99	1.30	1.25	6.16	3.02	2.58	9.18	9.00	11.76	11.00	2.37	2.00
1150	1.36	1.64	3.00	3.30	4.39	2.17	2.58	6.56	6.00	9.14	......	9.57	10.00
1151	1.71	1.73	3.44	3.30	6.51	1.49	1.78	8.00	8.00	9.78	10.00	6.01	6.00
1152	1.80	1.76	3.56	3.30	4.08	1.88	1.85	5.96	6.00	7.81	8.00	10.56	10.00
1153	0.85	1.78	2.63	2.40	4.19	1.46	1.75	5.65	6.00	7.40	8.00	10.48	10.00
1154	1.16	1.26	2.42	2.40	3.70	2.49	2.17	6.19	6.00	8.36	8.00	5.63	5.00
1155	1.91	1.48	3.39	3.28	3.45	3.14	3.57	6.59	6.00	10.16	7.00	10.04	10.00
1156	0.44	0.76	1.20	1.22	5.66	1.40	0.55	7.06	7.00	7.61	......	2.05	2.00
1157	0.76	1.02	1.78	1.64	3.85	4.93	1.33	8.78	8.00	10.11	9.00	3.23	3.00
1158	1.28	1.20	2.48	2.45	5.65	2.38	2.16	8.03	8.00	10.19	9.00	6.18	6.00
1159	2.32	1.40	3.72	3.69	5.38	3.53	1.17	8.91	7.00	9.08	8.00	10.54	10.00
1160	0.88	0.88	1.76	1.64	3.46	4.89	0.98	8.35	7.00	9.33	8.00	4.28	4.00
1161	1.38	1.16	2.54	2.46	3.45	2.59	2.40	6.04	6.00	8.44	7.00	10.33	10.00
1162	2.11	1.90	4.01	4.10	3.27	3.94	4.11	7.21	7.00	11.32	8.00	7.68	7.00
1163	1.24	1.24	2.48	2.46	7.58	1.63	1.05	9.21	9.00	10.26	10.00	4.54	4.00
1164	1.26	2.22	3.48	3.30	0.48	5.73	2.02	6.21	6.00	8.23	......	9.40	10.00
1166	2.93	0.92	3.85	4.10	2.81	4.75	0.64	7.56	7.00	8.20	8.00	8.79	8.00
1167	2.49	1.16	3.65	3.29	4.33	3.21	0.66	7.54	7.00	8.20	8.00	10.33	10.00
1168	......	......	1.80	2.47	......	......	......	......	5.00	20.13	23.00	......	......
1169	......	......	......	......	......	......	......	......	......	......	......	50.28	50.00
1170	15.42	......	15.42	14.81	......	......	......	......	......	......	......	......	......
1171	0.59	0.61	1.20	0.82	3.30	4.45	4.32	7.75	7.00	12.07	8.00	2.70	2.00
1172	1.00	0.84	1.84	1.64	2.36	5.15	0.99	7.51	6.00	8.50	7.00	6.91	6.00
1173	0.21	2.08	2.29	2.47	3.81	4.21	1.38	8.02	8.00	9.40	9.00	4.19	4.00
1174	1.69	1.29	2.98	3.29	4.21	4.27	1.29	8.48	8.00	9.77	9.00	7.41	7.00
1175	1.01	0.79	1.80	1.64	3.80	3.54	1.15	7.34	7.00	8.49	8.00	2.60	2.50
1176	1.00	3.74	4.74	5.50	......	......	......	......	......	17.86	16.00	......	......
1177	1.06	1.08	2.14	2.00	7.73	1.13	4.30	8.86	8.00	13.16	......	6.15	6.00
1178	3.39	0.76	4.15	3.29	6.83	1.11	0.87	8.00	8.00	8.87	......	11.55	10.00
1179	2.21	1.14	3.35	3.29	4.56	1.70	1.38	6.26	6.00	7.64	8.00	11.16	10.00
1180	1.96	1.06	3.02	2.88	6.20	1.86	1.11	8.06	7.00	9.17	8.00	8.80	8.00
1181	1.70	0.92	2.62	2.47	6.43	1.86	1.15	8.29	6.00	9.44	8.00	5.79	5.00
*1214	......	......	......	1.65	......	......	......	......	8.00	......	10.00	......	12.00
1182	0.18	1.34	1.52	1.00	1.96	5.32	4.93	7.29	7.00	12.22	9.00	2.11	2.00
1183	1.03	1.64	2.67	2.40	1.71	4.14	4.48	5.85	7.00	10.33	8.00	4.65	5.00
1184	0.84	2.11	2.95	3.30	5.02	2.24	3.89	7.26	7.00	11.15	9.00	9.23	9.50

* Sample received too late for analysis.

Descriptive List of Manufacturers' Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1185	Essex Complete Manure for Corn, Grain and Grass
1186	Essex Complete Manure for Potatoes, Roots and Vegetables
1187	Essex Market Garden and Potato Manure
1188	Essex XXX Fish and Potash
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, ME.
1189	Acid Phosphate
1190	Aroostook Potato Manure
1191	Dirigo Fertilizer
1192	Muriate of Potash
1193	Nitrate of Soda
1194	Sagadahoc High Grade Superphosphate
1195	Sagadahoc Special Potato Fertilizer
1196	XX Chemical Fertilizer
1197	Yankee Fertilizer
1200	3-6-10 Fertilizer
	SCIENTIFIC FERTILIZER CO., BUFFALO, N. Y.
1201	Scientific "Bone, Meat and Potash" Fertilizer
1202	Scientific "Corn and Grain" Fertilizer
1203	Scientific "Economy" Fertilizer
1204	Scientific "Potato" Fertilizer
1205	Scientific "Potato and Vegetable" Fertilizer
	SWIFT'S LOWELL FERTILIZER CO., BOSTON, MASS.
1206	Swift's Lowell Animal Brand
1207	Swift's Lowell Bone Fertilizer
1208	Swift's Lowell Cereal Fertilizer
1209	Swift's Lowell Dissolved Bone and Potash
1210	Swift's Lowell Empress Brand
1211	Swift's Lowell Potato Manure
1212	Swift's Lowell Potato Phosphate
1213	Swift's Lowell Superior Fertilizer

Analyses of Manufacturers' Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1185	0.97	2.91	3.88	3.30	5.90	3.75	1.50	9.65	7.00	11.15	9.50	9.36	9.50
1186	0.96	3.22	4.18	3.70	6.33	2.62	3.14	8.95	7.00	12.09	9.00	8.39	8.50
1187	0.79	1.55	2.34	2.00	5.25	5.17	2.65	10.42	8.00	13.07	10.00	5.06	5.00
1188	0.56	1.82	2.38	2.10	6.14	2.70	3.28	8.84	9.00	12.12	12.00	4.11	2.25
1189	......	......	......	......	16.86	0.95	0.80	17.81	16.00	18.61	17.00	......	......
1190	0.92	0.08	1.00	1.05	7.11	1.44	0.45	8.55	6.00	9.00	7.00	4.97	4.00
1191	0.13	0.44	0.57	0.85	6.62	0.89	5.46	7.51	6.00	12.97	9.00	3.32	3.00
1192	......	......	......	......	......	......	......	......	......	......	......	53.20	50.00
1193	15.58	......	15.58	15.00	......	......	......	......	......	......	......	......	......
1194	1.54	0.38	1.92	1.85	6.86	1.14	3.50	8.00	7.00	11.50	8.00	4.37	3.00
1195	1.33	0.58	1.91	2.00	4.63	1.66	4.54	6.29	7.00	10.83	8.00	9.83	8.00
1196	7.03	1.07	8.10	7.00	......	......	3.76	4.29	3.00	8.05	7.00	10.05	8.00
1197	0.35	0.41	0.76	0.40	7.30	2.73	1.04	10.03	7.00	11.07	8.00	3.05	2.00
*1200	......	......	......	2.47	......	......	......	......	6.00	......	7.00	......	10.00
1201	0.70	2.32	3.02	3.33	4.43	1.55	3.14	5.98	8.00	9.12	10.00	8.55	8.00
1202	0.52	1.32	1.87	1.66	5.55	1.71	1.51	7.26	8.00	8.77	9.00	2.47	2.00
1203	0.52	1.24	1.76	1.66	6.16	1.71	1.64	7.87	9.00	8.51	10.00	4.16	4.00
1204	0.71	1.92	2.63	2.50	4.26	1.20	2.70	5.46	8.00	8.16	10.00	6.23	6.00
1205	0.68	2.62	3.30	3.33	4.12	1.99	3.70	6.11	7.00	8.87	8.00	10.62	10.00
1206	0.86	1.46	2.32	2.46	7.85	1.34	0.94	9.19	9.00	10.13	10.00	4.56	4.00
1207	0.73	0.94	1.67	1.64	5.26	2.76	1.79	8.02	8.00	9.81	9.00	3.20	3.00
1208	0.34	0.50	0.84	0.82	5.22	1.76	1.32	6.98	7.00	8.30	8.00	1.18	1.00
1209	0.54	1.08	1.62	1.64	7.11	1.65	1.02	8.76	9.00	9.78	10.00	2.14	2.00
1210	0.35	0.77	1.12	1.23	6.03	1.12	0.66	7.15	7.00	7.81	8.00	2.11	2.00
1211	0.56	0.96	1.52	1.64	4.52	2.34	1.40	6.89	7.00	8.29	8.00	4.24	4.00
1212	1.31	1.16	2.47	2.46	5.66	2.49	1.71	8.15	8.00	9.86	9.00	6.35	6.00
1213	2.52	1.28	3.80	3.69	5.60	1.98	1.30	7.58	7.00	8.88	8.00	10.23	10.00

* Sample received too late for analysis.

RULE FOR CALCULATING VALUATION OF FERTILIZERS.

The commercial valuation will be accurate enough as a means of comparison if the following rule is adopted:

Multiply 3.5 by the percentage of nitrogen.

Multiply 0.8 by the percentage of available phosphoric acid.

Multiply 0.4 by the percentage of insoluble phosphoric acid.

Multiply 1.0 by the percentage of potash.

The sum of these four products will be the commercial valuation per ton on the basis taken.

Illustration. The table of analyses shows a certain fertilizer to have the following composition: Nitrogen 2.00 per cent; Available phosphoric acid 8.50 per cent; Insoluble phosphoric acid 3.50 per cent; Potash 3.25 per cent. The valuation in this case will be computed thus:

Nitrogen,	3.5 × 2.00,	$7 00
Available phosphoric acid,	.8 × 8.50,	6 80
Insoluble phosphoric acid,	0.4 × 3.50,	1 40
Potash,	1.0 × 3.25,	3 25
Valuation per ton,		$18 45

Since this rule assumes all the nitrogen to be organic and all the potash to be in the form of the sulphate, it is evident that the valuations thus calculated must not be taken as the only guide in the choice of a fertilizer. At best the valuations can only serve to show the approximate cost of the several ingredients contained in the fertilizer in question. In every case the farmer should consider the needs of his soil before he begins to consider the cost. In many instances a little careful experimenting will show him that materials containing either nitrogen, potash, or phosphoric acid alone will serve his purpose as fully as a "complete fertilizer," in which he must pay for all three constituents, whether needed or not.

Figure 1. The effect of an unbalanced ration (?)
See page 72.

ORCHARD NOTES.

W. M. Munson.

The fact that the apple grows in many parts of the State as though it were indigenous and that orchards will exist and bear a partial crop of fruit though seriously neglected, is responsible for much of the ill-treatment so common to the orchards of Maine. There is little doubt, however, that a well managed orchard is a most valuable farm property, and one of the surest sources of income. For many years the Experiment Station has devoted a large amount of attention to the orchard industry, as evidenced by its publications on this important subject. It is the purpose of the present bulletin to report recent observations and experiments upon successful orchard management.

Notes on Spraying.

"Watch and spray," as well as "cultivate and feed," must be the motto of the successful orchardist. The importance of watchfulness, and the direct value of spraying, as a means of holding in check insect and fungous enemies of the orchard, have been repeatedly urged by this Experiment Station * and in so far as suggestions made have been followed, the results obtained by the fruit-growers of the State have been satisfactory.

By the work of this Station it has been shown beyond doubt that, by spraying at the proper time, and in the proper manner, the canker worm, tent caterpillar and forest caterpillar may be held in check; that the "apple worm" or codling moth may be controlled; that scale insects may be destroyed; that the green aphis or plant louse may be killed; that apple scab, cracking of pears, and rotting of plums may be very greatly reduced;—and still spraying is not a common practice among the fruit-growers of Maine!

* Repts. Maine Expt. Sta. 1891, 1892, 1893, 1894; Buls. 8, 52, 56.

With the great orchardists of New York, Michigan and the Pacific slope, spraying is just as much a part of the regular work of fruit growing as is pruning, or even harvesting. No live orchardist of California or Oregon would think of omitting the five or six treatments with Bordeaux mixture and Paris green, or with kerosene emulsion or resin wash, as the case might demand, any more than he would omit frequent cultivation or irrigation. It is because of this thoroughness in the production of fruit, as well as in grading and packing, that the fruit growers of the northwest are able to send their fruit across the continent and so nearly control the local eastern markets.

REASON FOR SPRAYING.

The leaves of plants have two functions essential to life and health. They act, in a measure, as both lungs and stomach for the plant. Consequently if they are destroyed or diseased, the whole plant suffers; the crop of fruit is lessened; and the vitality of the plant is weakened. It is for this reason that spraying is of importance, even in those seasons when there is no fruit. Spraying is an insurance and not a remedy, and there should be a definite purpose in view for every application. Specific directions for controlling the leading insect and fungous enemies of the orchard are given in "How to Fight Apple Enemies," published by this Experiment Station and sent free to any one requesting it.

RESULTS OF SPRAYING.

In a recent canvas of the orchards of Wayne and Orleans counties, New York, by Dr. George F. Warren,* it was found that in Wayne county, of 66 sprayed orchards, representing 626 acres, the yield in 1903 was at the rate of 280 bushels per acre; while 107 unsprayed orchards, covering 673 acres, yielded at the rate of 253 bushels per acre. For the sprayed fruit the average price per barrel was $2.02; while for the unsprayed fruit the price was but $1.80.

* Bul. 226, 227, Cornell Univ. Expt. Sta.

Of 179 orchards canvassed in Orleans county the following report was made:

Yields and incomes from orchards sprayed different numbers of times.

How treated.	Yields.			Portion of crop barreled.	Incomes.		
	Number of orchards.	Number of acres.	Average yield per acre.		Number of orchards.	Number of acres.	Average income per acre.
Unsprayed	43	381.0	328	66	54	449.5	$103
Sprayed once	33	352.0	346	74	30	316.0	139
Sprayed twice	70	701.0	374	78	64	644.0	143
Sprayed three times	27	247.5	414	87	25	236.5	184
Sprayed four times	6	43.0	569	77	6	43.0	211

The significance of the figures given is so obvious that comment is unnecessary, except that they corroborate in full the experience of those who have practiced similar treatment in this State.

THE MENACE OF THE CATERPILLAR.

The approach of the gypsy moth and the brown-tail, has stirred the people of Maine to such an extent as to insure active steps for the control of these pests. Every year, however, trees are defoliated by canker worm, forest caterpillar, tent caterpillar, and similar enemies, with little attempt on the part of growers to protect themselves from damage.

It is well understood that the forest caterpillar appears in destructive numbers at more or less irregular intervals; only to disappear again, after ruining many orchards and defoliating hundreds of thousands of forest trees. This disappearance is caused by the rapid increase of natural parasites. With the destruction of the caterpillars, the parasites die, and so there is an alternation in the period when there are many and when there are few of these pests.

The last serious invasion of the forest caterpillar was in 1897 and 1898, when whole orchards were swept as if by fire for two successive seasons. The results were naturally disastrous. It is now nearly time for a return of this caterpillar and the enterprising orchardist will be ready to meet it.

That the pest may be held in check was plainly demonstrated by the work of the Station during the last invasion. A large orchard of Baldwins which was sprayed with Paris green when the caterpillars first appeared and twice afterwards, was almost free from injury, while adjoining trees, not sprayed, were completely defoliated, and never recovered from the injury. The accompanying cuts represent the condition of the two orchards late in June.

Similar results have repeatedly been obtained in fighting the canker worm. It is highly important, however, that, for either of these pests, spraying be done just as soon as the leaves begin to unfold, and again in about a week or ten days. After the larvæ become half grown, spraying is not always effective.

Another precautionary measure to be borne in mind, in dealing with the forest caterpillar, is to prevent migration from tree to tree, and from forest trees to the orchard trees. This may be effected by placing a band of tarred paper about the trunk of the tree and smearing this with a thick coating of equal parts of lard and sulphur. It is very important that this mixture be not placed directly on the bark of the tree, as injury almost invariably results.

The method here noted was used with remarkable success in the orchards above mentioned. The caterpillars gathered by the hundred beneath the band, but would not cross the line, and were readily disposed of by means of a swab dipped in a very strong solution of washing powder. The masses of caterpillars upon the limbs were destroyed in the same way; those that escaped by dropping to the ground being stopped by the bands, and then killed as above.

OYSTER-SHELL BARK LOUSE.

An insect which is nearly as destructive as the dreaded San Jose scale, is annually doing thousands of dollars worth of damage in the State without the slightest notice on the part of farmer or fruit grower. This insect—the oyster-shell bark louse—is so familiar, and yet so inconspicuous, that it is usually overlooked. The insect is fully described in Bulletin 56 of this Station, to which the reader is referred. It frequently is the unsuspected cause of the stunted, sickly appearance of certain trees to be found in almost every orchard. The mature form, shown in

Figure 2.
The menace of the caterpillar.—Trees not sprayed.
See page 67.

Figure 3.
The menace of the caterpillar.—Result of spraying with arsenical poisons.
See page 67.

figure 5, may very readily be seen where the foliage is off. Every young orchard should be examined early in the spring and, if found infested, should be thoroughly treated with caustic soda or some other strong alkali.

The eggs of this insect hatch in June, or early in July, and the little lice travel rapidly over the surface of the young wood and the fruit until they find a satisfactory feeding ground, when they insert their beaks and begin their campaign against the life of the tree. Figure 4 shows the young lice, natural size, early in July.

Spraying the trees thoroughly with kerosene emulsion when the lice are in the migratory stage, as described in "How to Fight Apple Enemies," has in every instance, at the Station, been effective in controlling this pest.

APPLE SCAB.

Another ever present, and very generally neglected, pest of the orchard is the fungus disease, apple scab, or "black spot" as it is sometimes called. This disease, figure 8, has been so frequently described as to be perfectly familiar. As shown in former reports of this Station,* spraying is effective in securing a crop of fruit relatively free from this disease, even in those seasons when the scab is most prevalent.

For several years the conditions in most parts of Maine have been such that the fruit has been relatively free from scab, and as a result many growers who took up the practice of spraying some years ago, have gradually ceased to spray. It should be said, however, that this neglect is wholly comparable to the neglect which permits the lapse of a fire insurance policy. It may be unnecessary to spray to secure a crop of fair fruit one year, or even two or three years in succession; but when the unfavorable season does come, if spraying has been neglected, there is frequently a needless loss of several hundred barrels of fruit in orchards of average size.

As a result of the studies above mentioned † the fact was clearly demonstrated that, in a bad season, there was a difference of 50 per cent in the amount of perfect fruit upon sprayed and unsprayed trees; the best results being obtained from the use

* Ann. Rpt. Maine Expt. Sta. 1891, 1892, 1893, 1894.

† See details and summary, Rpt. Maine Expt. Sta., 1893, 125-128.

of Bordeaux mixture. In other words, trees not sprayed gave on three successive years 4.1, .9, and 38.2 per cent of the fruit free from scab; while the same years an equal number of trees sprayed with eau celeste (copper sulphate, carbonate of soda and ammonia) gave 57.8, 30.1 and 72.8 per cent respectively. The third year Bordeaux mixture was used and gave still better results—79.9 per cent of the fruit being free from scab.

From these, and similar results obtained all over the country, it is evident that spraying has ceased to be an experiment as a means of controlling certain orchard diseases. The results above cited have been repeatedly confirmed both at this Station and elsewhere. Reference is made to the subject at this time only to emphasize the importance of using precautionary measures. Even though there be no crop of fruit, the increased vigor of the trees as a result of clean healthy foliage, will far more than repay the cost of spraying. This spraying with Bordeaux mixture should be done first before the buds burst, and again immediately after the blossoms fall, if but two treatments are to be given. If the season is very wet, however, at least four treatments at intervals of two or three weeks are found to be advantageous.

PINK ROT.

In 1902 a comparatively new fungous disease made its appearance to a very destructive extent in western New York. This disease, known as "Pink Rot," because of its pinkish, mildew-like appearance, had long been known to botanists but only, or mainly, as a saprophyte, or fungus which grows on dead or decaying matter. It did not come under the writer's personal observation until the present season; although said to have been destructive to stored apples in Maine in 1902.

The appearance of this trouble is well shown in figure 9, from a photograph of fameuse apples grown at the Station the past year. The best description of the trouble, with a full account of its life history, is given by Eustace in Bulletin 227 of the New York Agricultural Experiment Station.

The disease attacks the fruit on the scab spots, where it appears like a pinkish mildew. Later in the season, the spots become brown, sunken and rotten. If badly attacked the whole fruit soon decays. Because of its appearance only on the scab spots, many have regarded it as simply another form of the

apple scab. Others have referred to it as a parasite on the scab fungus. Eustace maintains, however, that "there is absolutely no connection between the two. The only part that the scab had in the matter was that it ruptured the epidermis (skin) of the apple, thus making an entrance for this fungus to grow into the tissue and cause the rot."

A distinctive characteristic of this disease is that the decayed spots are rather dry and corky, and not very deep. Apples thus affected might, in some cases, be used for evaporating, as the diseased portion could be removed in paring; but because of the bitter character of the rot, affected fruit would be worthless for cider.

The disease is specially destructive to stored fruit, the "sweating" of the fruit furnishing just the right conditions for its rapid development. Eustace reports that: "It was noticeable that the fruit in the bottom of large bins, such as are used about cider mills and drying houses, would become one mass of decay if allowed to remain there longer than a few days." * It was in stored fruit that the loss before mentioned occurred in Maine.

As is well known, the "scab" is ever with us, and growers have become accustomed to its disfiguring presence; but with the advent of this destructive secondary enemy, the importance of warding off the attack of both becomes imperative. Thorough spraying with Bordeaux mixture is the only safe means of preventing this trouble.

Effect of an Unbalanced Ration?

In 1904 an obscure disease affected the fruit of certain trees in the orchard of Mr. Chas. S. Pope, Manchester. No similar trouble had ever come under the notice of the writer and this note is made simply as a matter of record. A careful study of the cause of the condition described is being carried on at the present time.

In August, when about the size of walnuts, the fruits began to crack and to drop. Marked indentations, somewhat similar to those made by curculio, were abundant. No evidence of insect work could be discovered, however. When the fruit was opened, the tissue under the indented parts was found to be dry

* Bul. 227, N. Y. Expt. Sta., 373.

and brown. Most of the fruit ceased to grow, and by the first of September the larger part of it was on the ground; though early in the season all the trees were well loaded. The leaves, however, appeared perfectly healthy.

At the time of harvesting, October 10, most of the trees had lost all of their fruit. Such as remained on some of the trees was, for the most part, small and deformed. Some of the fruit, however, was of medium size with one side cracked as in figure 1, and a small portion was without marked blemish. In all cases, however, the texture of the fruit was soft and spongy,—about as might be expected in April or May. The surface of the fruits was also characteristic, there being numerous minute elevations or "pimples," corresponding to the grayish dots on the fruit. This feature is shown in figure 1, and was so noticeable that the workmen spoke of it in handling the fruit after removal to the cellar. Though a small portion of the fruit was on the trees at harvest time, it dropped so easily that no attempt was made to save it for packing. The slightest jarring of the limbs would cause it to fall.

The reason for the condition above indicated is, as already noted, very obscure. A careful microscopic examination was made without finding evidence of any fungous enemy, even in the brown dry tissue above mentioned. It was then observed that the condition existed only with certain trees included in a fertilizer experiment in which an excess of available nitrogen is applied every year. The first tree noticed was in the plat receiving nitrate of soda and acid phosphate, and later it was found that every tree on this plat, as also on the adjoining plat which received nitrate only, was affected as described. In one or two instances check trees which adjoined the nitrate plat, and received no direct application of fertilizer, showed a tendency in this direction. None of the other trees in the whole orchard, however, gave the least indication of the trouble. A fertilizer plat on which were muriate of potash and acid phosphate, and another on which was muriate only, separated from the first by only a single row of trees, were entirely free from the disease.

The supposition was therefore made that the trouble was physiological and due to the excessive amount of available nitrogen and the lack of potash. Of course this is a matter of conjecture and can be settled only by definite and careful experiment.

In partial support of the supposition adopted, is the report of Mr. P. L. Ricker of the U. S. Department of Agriculture to whom specimens of fruit and leaves were sent. Knowing nothing of the conditions under which the trees were growing, Mr. Ricker reports: * "I can make out no signs of any fungus mycelium in the apple. There is a little ordinary mould around one of the holes in the apple, but not in condition to determine. It is not connected with the disease of the apple—if it can be so called. The main trouble seems to be from the bites of curculio. * * * The apples have been in a moist chamber ever since they came but no fungus has developed yet. There is a little core rot in some of them, the cause of which is not definitely known, but it is physiological and supposed to be due to some trouble in nutrition, or perhaps some root trouble. This, however, can only be determined by examining the roots and the conditions under which the tree was growing. There are none of the fungous diseases on the leaves, either. * * * Of course none of the physiological diseases can be determined from samples of the plants sent. A careful study of them in their natural surroundings is necessary, with, perhaps, experiments looking towards the improvement of soil conditions."

The outcome of a further study of this problem may be of much interest and some importance in connection with the rational fertilization of orchards.

Winter Injuries to Trees.

The injuries to trees during winter, in Maine, are usually due to the freezing of buds or young wood, and to girdling by mice. Both classes of injury have been emphasized by the severe winters of the past two or three years.

FREEZING.

The winters of 1903-4 and of 1904-5 were exceptionally severe in Maine, and as a result many complaints were made that the apple orchards had suffered more than for the previous twenty years. An explanation of this condition is not difficult; and a partial remedy is easily applied. More important than a remedy, however, is an awakening to the need of using measures which will prevent a recurrence of the trouble in the future.

* Personal letter to the writer Oct. 21, 1904.

There is little doubt that, to a large extent, the injury noted was due to the full crop of fruit borne in 1904, immediately following a trying season, and succeeded by a particularly severe winter. In the early part of the season of 1903, there was a very slight rainfall. This drought was followed late in the season by excessive rains which caused a full development of fruit buds and late growth of wood. Though the trees did not appear to suffer much after the trying winter which followed, they were doubtless considerably weakened, and the heavy loads of fruit borne in the next season left them in an exhausted condition before the second severe winter came on. From the first, the winter of 1904-5 was trying. In December there were twenty-six mornings when the mercury went to zero or below, and several times during the winter 20° to 30° below zero were reached. As a (probable) result of these conditions, the trees suffered as indicated. In almost every case coming under the writer's observation, the trees which suffered most were those which bore a full crop the previous year.

The injury was manifested by the killing of the smaller limbs, and in many cases by the death of the whole tree. The central portions of the tops of many Gravenstein trees were ruined. Many Baldwin tops were thinned. So far as observed, however, there was not a marked difference in the destruction of nursery grown Baldwins as compared with those top-worked on seedling stocks; although it is commonly supposed that the trunk of the Baldwin is tender.*

Trees which had been well cultivated and fertilized, if allowed to overbear were, in many cases, ruined. One Baldwin tree which bore 8½ barrels of fruit in 1904 (see figure 10, Bul. 122) was practically ruined. There is little doubt that had one-half of the fruit been removed from such trees early in the summer, less trouble would have been experienced.

In neglected orchards, or in many cases where good thrifty orchards were left in sod, the injured trees continued to deteriorate, and many died later in the season. In those cases where the land was plowed and fertilized, however, the trees started a new growth of vigorous shoots near the base of the main limbs, and it will be possible to build a new top on such.

*In Bulletin 269, N. Y. Agr. Expt. Sta., page 336, Eustace reports that in 1903 young nursery trees of Baldwin are very susceptible to injury by cold; and Baldwin and Gravenstein are reported as injured most by some New York growers.

Mr. F. H. Morse of Oxford County, Me., reports injury to the Baldwin trunks in winter of 1904-5.

Those orchards which were not pruned last spring should be treated *at once;* all dead wood being removed and injured branches being shortened, to give the new wood a chance to develop. In many cases, too, if a vigorous growth was made last season, cions may be set which will aid in re-forming a good top.

To prevent future injury in this way, avoid allowing the trees to be over loaded with fruit. The fact that as many barrels of fruit may be secured, with much less strain on the vitality of the trees, as a result of systematic thinning, has been fully demonstrated; and the price received for such thinned fruit will usually be enough higher to pay cost of labor. In fact the fruit must be harvested at some time, and it is wiser to remove wormy and deformed fruit in August, rather than in October.

Proper cultivation and feeding will go far toward putting trees in condition to withstand a severe winter; but in no case should cultivation be continued later than August 1st to 10th. A cover crop of some kind sown at the time of last cultivation will often aid in checking late growth of trees.

Young trees which fail to mature their wood before cold weather, frequently suffer. Such trees should have the young wood pinched back about the time of the first frost,—about the middle of September at Orono; two weeks later in the southern part of the State.

MICE.

More complaint as to winter injury by mice was heard during the past season, than since 1891. Whole orchards of bearing age were ruined. The attention of the writer was called to trees ten inches in diameter which were almost completely girdled. This condition was of course due to the very severe winter with the prevailing deep snows from early December till late in March. While so much trouble may not be experienced again for some years, it is liable to occur at any time; and the careful orchardist will not only repair past injuries but, as far as possible, prevent future ones.

Any ordinary case of girdling by mice may easily be repaired by "bridge grafting." This consists simply in trimming the edges of the mangled bark back to where it is firm and healthy, and inserting cions at intervals of an inch or two around the girdled portion. This is done by raising the bark, both above

and below the girdle, with the point of a knife, and putting under it the end of a cion which has previously been made wedge shaped at each end. The cion must be fresh, vigorous, young wood and may be of the same tree, or of any other variety. When finished the work will be as indicated in figure 6.

To prevent drying of the wood, and of the edges of the bark before the cions unite, it is well to cover the injured part with a plastic made of clay and cow dung, and cover the whole with a piece of burlap,—as an old fertilizer sack.

A tree nearly a foot in diameter was treated by the writer as described last spring, and every cion united and made a good growth during the summer.

Figure 7 shows a pear tree about thirty years old that was bridge grafted when young. It is now more than a foot in diameter and bears well every year.

Better than repair, however, is the prevention of injury to a young orchard. This may easily be accomplished by the use of some protective covering at the base of the tree. The most common materials used are wire screen, tarred paper, and wood veneer.

The protectors should be about two feet high, otherwise they are not always effective. They should also be pressed into the ground so that mice cannot crawl under. The first cost of the wire screen is greater than that of the others, but as it lasts several years, and requires no attention after the first putting on, the cost is more than balanced by reduced amount of labor.

The practice at the Station has been to get a roll of 3-foot wire cloth and cut it into strips two feet long. These strips would then make four protectors, each nine inches wide. There is an advantage in using 2-foot wire, if available, because of the selvage ends, and the reduced amount of cutting required. These strips are put loosely about the tree and held in place with small annealed wire at top, middle, and bottom.

The strips of tarred paper are put on in the same way as the wire cloth, and usually held in place with pieces of twine. It is very important, however, that the paper be removed in the spring, as otherwise the trees are in danger of scalding. The material for protecting 400 young trees with wire last year, cost $7.50. Tarred paper for an equal number cost 84 cents,—refuse binding twine being used as tying material. The time required for applying was about the same in each case. Next spring,

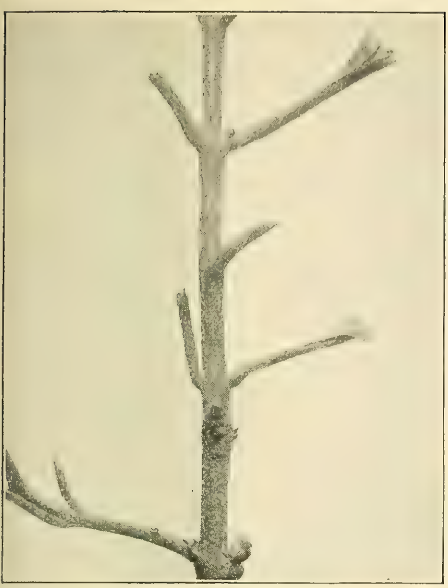

Figure 4.
Oyster-shell bark-louse,—just hatched.
See page 69.

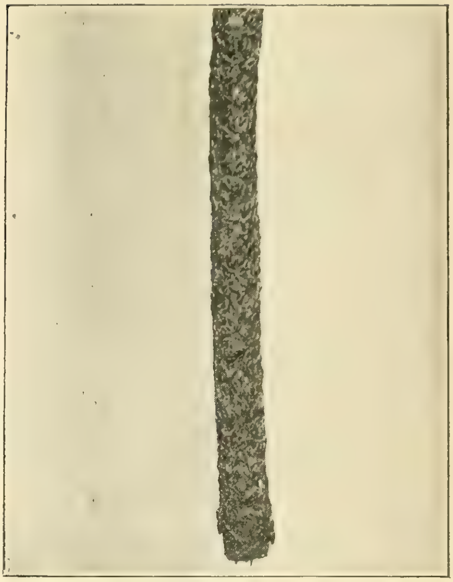

Figure 5.
Oyster-shell bark-louse,—mature form.
See page 69.

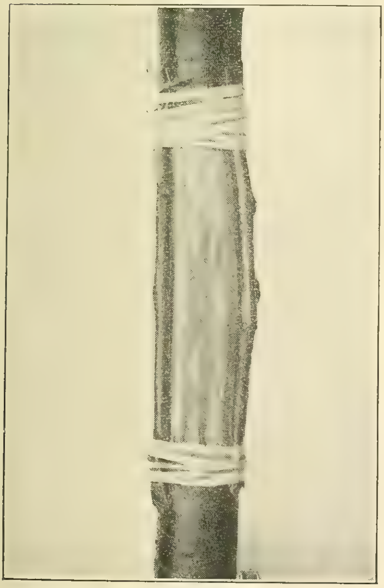

Figure 6.
Bridge-grafting of a girdled tree.
See page 76.

Figure 7.
Saved by bridge-grafting.
See page 76.

however, the paper must be removed, only to be renewed the following winter, while no further attention need be given the wire.

Strips of wood veneer, costing $5.00 per thousand, are largely used in the western states. About 200 of them were used in comparison with the other materials named. Very little time is required for applying them, as no tying is needed, but the work must be done before freezing weather comes, or many of them will crack and be worthless.

Another protective measure which has been used with satisfactory results is the tramping of the snow about the bases of the trees after a heavy storm. This make a wall of ice which serves as a barrier. If, after tramping, a covering or mulch of stable manure is applied, there is less probability that further tramping will be needed.

Still another, and cheaper, method of protection, is to apply a coat of paint to the tree. Many fear the effect of the paint, but if pure materials are used no ill effect appears to follow. On nursery trees at the Station, white lead, zinc white, and a special preparation, "Tanglefoot," have been used. While it cannot definitely be said that any of these keep the mice away—since none of the other trees in the nursery have suffered—no injury to the trees has in any case resulted.

Suggestions as to Handling Fruit.

Just when and how to pick fruit depends largely upon the kind of fruit, the distance it must be shipped, and the demands of the market supplied. If one is delivering fruit directly to the consumer, and catering to a so called "fancy market," he must see that the produce is in the very finest desert condition, and fully ripe before picking. Consumers of such fruit are always willing to pay an extra price for the advantage of having it in the highest state of perfection.

The process of ripening is incipient breaking down of plant tissue, and there is no well marked distinction between "greenness," "ripeness" and "decay." One stage passes into the other insensibly, and it may be seen that the riper the fruit the sooner the breaking down of the tissues (in other words decay) may be expected. Fruits that are picked when very green or immature will not break down so quickly as those that are

farther advanced. As a rule, however, such fruits never reach the most edible stage, and they frequently shrivel and become unmarketable. Many of the peaches brought into the markets of Maine are, because of too early picking, totally unfit for use, but we eat them,—and some call them good. Some of the winter apples, like Roxbury Russet, and Ben Davis, if harvested too early, will shrivel and become practically worthless before spring.

The precise stage at which fruit may be most advantageously harvested is a matter which each grower must decide for himself, in accordance with the conditions of his market. Some successful orchardists depend upon Williams' Favorite as their chief market apple, allowing the fruit to ripen on the tree and marketing only choice dessert specimens. Naturally such a course would be possible only when there is a good local market.

It may be superfluous to suggest how to pick fruit. Nevertheless this is one of the most important factors in the successful handling of the product. The hiring of cheap laborers for picking is of doubtful economy, although for many kinds of work such laborers, who will do as told, are valuable help, even though not familiar with the details of the business. In general, however, the picker should understand the importance of his work, and should bear in mind the fact that every evidence of handling detracts from the market value of the fruit. There is a general notion that any one can pick apples, but such is not the case; and every year large amounts of fruit are lost and many trees permanently injured by careless or ignorant pickers. During the past season some of the Tolmans and Alexanders in the Station orchards were rendered almost unsaleable because the pickers grasped the fruit so firmly as to leave an imprint of every finger on the apple.

It is, perhaps, unnecessary to urge that usually the apple is not ready for harvest until it will part readily from the fruit spur. The fruit should never be pressed with thumb and fingers, or thrown into a basket or bag. All fruit should be handled as carefully as would be necessary with eggs.

During the last apple harvest, in spite of the high price of fruit, the writer saw a prominent farmer carefully hand pick his Baldwins and Greenings and then pour them into fertilizer sacks to carry to the cellar. Nor, strange to say, is this unusual with

many farmers who grow a few apples as a side issue. Almost every day, otherwise good fruit is brought to market in this careless manner. It is frequently the man who handles fruit in this way who complains that fruit growing is not a profitable feature of his farm work.

Pears are frequently injured by being left on the trees too long. These should be gathered just as soon as they will part from the tree readily, and should be ripened in a cool, dark place. In the case of winter pears, the usual guide for harvesting is the time when the pears begin to drop.

Suggestions on Pruning.

Intelligent pruning at the right time is absolutely essential to the production of the best fruit. An unpruned tree may, in many instances, produce a larger number of apples than an adjacent pruned tree; but the percentage of merchantable fruit will invariably be smaller. Small apples contain just as many seeds as large ones, and therefore make practically as great demands on the store of plant food. They do not, however, fill the basket, nor the pocketbook, so rapidly as the others.

The amount of pruning necessary depends largely upon the location and exposure of the orchard. Trees on a warm, southern slope, freely exposed to the winds, require much less pruning than do those in a cool, sheltered location which is lacking in sunshine. Plenty of light is essential to the production of highly colored fruit. It is desirable that trees should be pruned intelligently from the time they are set, but old trees may often be given a new lease of life by judicious management. If the trees have been long neglected and require heavy pruning, do not remove all of the wood the first year. Removal of a portion of the top, thus distributing the food gathered by the roots to a smaller number of branches, tends to produce rapid growth and a renewed vigor of the tree. The removal of too much at one time, will start the growth of water-sprouts and defeat the very purpose in view.

The best time for pruning is on warm days from January to May. More can be accomplished in the longer days of March, April and May, but many prefer to go through the orchard on the crust of a deep snow. The time of year when the cut is

made has little effect on the readiness with which the wound heals, but more care is necessary to prevent injury to trees pruned when the wood is frozen.

A wound made by removing a limb heals best if the cut is made close to the trunk or branch. A stub two or three inches long does not heal, and becomes a lodging place for spores of fungi and bacteria which cause decay and death of the tree. The splitting down of large limbs may often be avoided when pruning, by sawing in from the under side first; but in every case, see that the wound is left clean and smooth. Wounds should also be covered immediately with a coat of paint, shellac, or grafting wax to keep out the moisture and the spores before mentioned.

Figure 8. Apple Scab. See page 69.

Figure 9. Pink Rot. See page 70.

FEEDING STUFF INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of inspection analyses.

CHIEF REQUIREMENTS OF THE LAW.

The points of the law of most interest both to the dealer and consumer concisely stated, follow.

Kinds of Feed Exempt Under the Law. The law applies to all feeding stuffs *except* the following: hays and straws; whole seeds, meals, brans and middlings of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn, sold separately; wheat bran and middlings mixed together and pure grains ground together.

Kinds of Feed Coming within the Law. The principal feeds coming under the provisions of the law are linseed meals, cottonseed meals, cottonseed feeds, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewer's grains, dried distiller's grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, corn and oat feeds, corn bran, ground beef or fish scraps, foods, poultry foods, stock foods, patented, proprietary and trade mark stock and poultry foods, mixed feeds other than those composed solely of wheat bran and middlings mixed together or pure grains ground together, and all other materials of similar nature.

The Brand. Each package of feeding stuffs coming within the law shall bear, conspicuously printed, the following statements:

The number of net pounds contained in the package.

The name or trade mark under which it is sold.

The name of the manufacturer or shipper.

The place of manufacture.

The place of business of manufacturer or shipper.

The percentage of crude protein.

The percentage of crude fat.

The Adulteration of Feeding Stuffs. If any foreign substances are added to whole or ground grain or wheat offals, the true mixture must be plainly marked upon the packages.

Duties of the Director. The Director shall in person or by deputy analyze at least one sample of each feeding stuff coming within the requirements of the law, and publish the results with such additional information as circumstances advise. He shall report all violations of the law to the Commissioner of Agriculture.

Penalties. The sale or offering for sale of feeding stuffs not properly branded, or containing a smaller percentage of protein and fat than are guaranteed, or of adulterated feeding stuffs, is punishable by a fine not exceeding $100 for the first, and $200 for each subsequent offense.

Results of the Inspections for 1905-6.

The last bulletin on feeding stuff inspection was published in April, 1905. Prior to 1904 it had been the custom of the Station to collect a large number of samples of the feeding stuffs offered in the State for the purpose of analyses. With few exceptions the feeding stuffs are running fairly constant in composition, and for the past two years, greater attention has been paid to proper inspection than to the analyses. At least one sample has been drawn of each of the commercial feeding stuffs offered in the State, so far as they have been found by the inspector. In the parts of the State where the greater amount of feeding stuffs are used, four inspections have been made. There is an evident desire on the part of nearly all of the dealers, large and small, to conform to the requirements of the law, and with the single exception of mixed feeds (see discussion page 96), there is every reason to feel satisfied with the quality of the concentrated commercial feeding stuffs upon the market.

Unless with the possible exception of a single jobbing house, all of the large handlers of feeds appear to be trying to do a perfectly square, legitimate business. There has been a very marked improvement in the quality of goods, and particularly in their uniformity, since the enactment of the feeding stuffs law eight years ago. Not only have the feeders a better understanding of the feeds they use but the dealers have become aware of the quality of their goods, and why feeding stuffs differ from one another in feeding value.

The table on pages 83 to 88 gives the results of the analyses.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Prime Cotton Seed Meal ... American Cotton Oil Co	42.38	41.00	8.80	9.00	2068
	41.50	41.00	–	9.00	2212
Cotton Seed Meal ... Butler Kyser Oil Co	41.88	38.61	8.68	–	2187
Imperial Brand Prime Cotton Seed Meal ... C. A. Tindall & Co., Memphis, Tenn	41.63	40.00	7.64	8.50	2133
	39.13	40.00	–	8.50	2164
	41.50	40.00	–	8.50	2189
Green Diamond Brand Cotton Seed Meal ... Chapin & Co	42.44	43.00	8.56	9.00	2084
	41.13	41.00	–	9.00	2172
Magnolia Brand Cotton Seed Meal ... Chas. M. Cox Co	43.44	43.00	–	9.00	2035
	40.63	43.00	8.38	9.00	2071
	41.50	43.00	–	9.00	2209
Phœnix Cotton Seed Meal ... D. L. Marshall	41.38	41.00	9.30	9.00	2085
	41.63	41.00	–	9.00	2169
	41.50	41.00	–	9.00	2126
Owl Brand Cotton Seed Meal ... F. W. Brodé	42.25	41.00	9.03	7.00	2083
	42.63	41.00	–	7.00	2109
	42.75	41.00	–	7.00	2167
Cotton Seed Meal ... H. E. Bridges & Co	43.00	43.00	–	9.00	2067
	40.06	43.00	–	9.00	2122
	40.94	43.00	10.50	9.00	2195
	40.56	43.00	–	9.00	2208
Dixie Brand Cotton Seed Meal ... Humphreys, Goodwin & Co	37.75	41.00	–	9.00	2131
	41.19	41.00	10.83	9.00	2140
	41.00	41.00	–	9.00	2210
Prime Cotton Seed Meal ... Hunter Bros. Milling Co	40.44	41.00	–	9.00	2066
	41.25	41.00	8.78	9.00	2073
	39.25	41.00	–	9.00	2115
	37.69	41.00	–	9.00	2116
	41.25	41.00	–	9.00	2121
	38.38	41.00	–	9.00	2125
	40.63	38.00	–	–	2156
Cotton Seed Meal ... J. E. Soper & Co	44.88	41.00	10.18	9.00	2107
	41.88	41.00	–	9.00	2155
Indian Brand Cotton Seed Meal ... National Cotton Seed Products Co	42.75	40.00	–	8.50	2002
	38.81	41.00	–	–	2045
	43.00	41.00	7.78	–	2136
	41.50	41.00	–	–	2214
Star Brand Cotton Seed Meal ... Sledge & Wells	39.13	43.00	–	9.00	2003
Star Brand Cotton Seed Meal ... J. T. & R. S. Wells	40.25	41.00	9.40	9.00	2086
	41.38	41.00	–	9.00	2161
Cotton Seed Meal ... Southern Cotton Oil Co	41.69	38.61	–	–	2132
	41.50	38.61	10.13	–	2176
Old Gold Cotton Seed Meal ... T. H. Bunch	41.63	41.00	8.13	9.00	2079
	42.50	41.00	–	9.00	2181

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	PROTEIN. Found—per cent.	PROTEIN. Guaranteed—per cent.	FAT. Found—per cent.	FAT. Guaranteed—per cent.	Station number.
Eagle Brand Cotton Seed Meal	41.63	43.00	10.60	9.00	2014
W. A. Kaiser & Co.	40.06	43.00	–	9.00	2044
Battle Brand Prime Cotton Seed Meal	43.00	43.00	7.60	9.00	2134
W. P. Battle & Co., Memphis, Tenn	40.56	43.00	–	9.00	2213
Cotton Seed Meal	37.13	–	–	–	2005
From correspondents, brands not given	44.94	–	–	–	2110
	42.25	–	–	–	2111
Cotton Seed Meal	42.75	–	–	–	2011
Samples sent by jobbers to learn quality	*42.75	–	–	–	2015
	*40.69	–	–	–	2016
	*42.25	–	–	–	2017
	*43.75	–	–	–	2018
	*39.75	–	–	–	2030
	*37.88	–	–	–	2031
	*39.50	–	–	–	2032
	*33.38	–	–	–	2033
	*40.69	–	–	–	2034
	*24.50	–	–	–	2048
	*25.19	–	–	–	2049
	42.25	–	–	–	2111
	42.13	–	–	–	2119
	41.25	–	–	–	2120
Glenwood Cotton Seed Feed	19.81	22.00	5.08	5.00	2174
D. L. Marshall Co	23.13	22.00	–	5.00	2183
Linseed Oil Meal	38.13	37.00	–	1.00	2007
American Linseed Co	37.00	37.00	3.88	1.00	2093
	36.38	36.00	2.30	1.00	2182
Viscid Oil Meal Milwaukee Elevator Co	28.81	31.00	11.63	7.50	2196
Chicago Gluten Meal	33.56	–	–	–	2050
Glucose Sugar Refining Co	32.88	38.00	2.45	3.00	2088
	34.19	38.00	–	3.00	2168
Jenks' Gluten Meal Huron Milling Co	31.06	36.00	7.70	5.00	2095
Gluten Feed Douglas & Co	22.69	26.50	3.30	3.30	2173
Buffalo Gluten Feed	23.69	25.00	2.70	3.00	2080
Glucose Sugar Refining Co	25.00	25.00	–	3.00	2162
Jenks' Gluten Feed	28.56	27.00	–	7.50	2012
Huron Milling Co	27.25	27.00	–	7.50	2025
	29.38	27.00	–	7.50	2036
	28.25	27.00	8.98	7.50	2070
	33.38	27.00	–	7.50	2127
	31.88	27.00	–	7.50	2175
Bay State Gluten Feed J. E. Soper & Co.	21.06	26.00	4.73	3.00	2194
Tiger Gluten Feed	25.00	25.00	4.00	2.75	2082
St. Louis Syrup and Preserving Co	25.63	25.00	–	2.75	2188

* So far as known these goods were not sold in Maine.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Warner's Gluten Feed / Warner Sugar Refining Co	22.13 23.19	25.00 25.00	5.93 –	3.00 3.00	2077 2198
Gluten Feed / Brand not known. Jobbers sample	*27.56	–	–	–	2128
Anchor Distillers' Grains / C. A. Krouse Grain Co., Milwaukee, Mich	16.00 15.56	† †	5.88 –	† †	2094 2211
Continental Gluten Feed / Continental Cereal Co	31.63 29.69 31.44	35.00 35.00 35.00	– 14.88 –	12.50 12.50 12.50	2062 2180 2200
Ajax Flakes / Flint Milling Co	34.00 28.88	34.00 34.00	13.40 –	12.00 12.00	2097 2184
Biles Fourex / J. W. Biles Co	34.25 32.19	33.00 33.00	11.65 –	11.00 11.00	2076 2177
Biles Ready Ration, Union Grains / J. W. Biles Co	24.63 22.81	24.00 24.00	7.23 –	7.00 7.00	2091 2163
Molasses Dairy Feed / American Cereal Co	14.19	16.00	3.24	3.00	2123
Molasses Horse Feed / American Cereal Co	11.00	11.00	2.84	3.00	2124
Schumachers' Stock Feed / American Cereal Co	10.75 11.75	12.00 12.00	5.18 –	5.00 4.00	2078 2178
Quaker Dairy Feed / American Cereal Co	15.75	14.00	4.63	3.50	2146
Victor Corn & Oat Feed / American Cereal Co	8.50 9.63	9.00 9.00	4.35 –	4.00 4.00	2106 2165
Sucrene Dairy Feed / American Milling Co	15.13 17.50 12.13 14.81	16.50 16.50 16.50 16.50	– – 2.58 –	3.50 3.50 3.50 3.50	2059 2060 2158 2216
Sucrene Horse Feed / American Milling Co	13.19	13.50	3.38	3.50	2157
Blue Grass Mixed Feed / A. M. Waller & Co	10.19	11.59	2.68	3.19	2207
Queen Stock Feed / Brown Milling Co	7.81	9.20	2.58	4.10	2099
Horse Feed / Buffalo Cereal Co	12.00 12.13	12.00 12.00	5.13 –	4.50 4.50	2072 2170
Green Diamond Sugar Feed / Chapin & Co	16.31 12.69	16.50 16.50	4.00 –	3.50 3.50	2083 2153
Triangle Calf Feed / Chapin & Co	23.75	22.00	13.03	10.00	2139
Wirthmore Hominy Feed / Chas. M. Cox Co	11.13	10.50	9.80	7.50	2150

*So far as known this did not come into Maine. † 25% protein and fat.

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Wirthmore Wheat Feed Chas. M. Cox, Agents	16.00	17.00	4.65	4.00	2074
Empire Feed Empire Mills, Olean, N. Y.	8.25 8.38	7.63 7.63	4.08 –	3.97 3.97	2069 2179
Pearl Oat Feed Flint Milling Co	9.69 10.25	10.00 10.00	8.23 8.18	6.00 6.00	2092 2185
Vulcan Blended Grains Flint Milling Co	24.25	24.00	6.21	7.00	2143
Ioko Poultry Food Flint & Stetson, Damariscotta	21.88	21.00	6.53	4.50	2118
Boss Corn & Oat Feed Great Western Cereal Co	7.94	9.00	4.05	4.00	2205
Royal Oat Feed Great Western Cereal Co	5.44	7.60	1.57	2.80	2138
Monarch Chop Feed Husted Milling & Elevator Co	7.94	8.09	4.00	4.16	2108
H-O Horse Feed H-O Co., Buffalo	13.63 13.63	12.00 12.00	5.53 –	4.50 4.50	2087 2206
New England Stock Feed H-O Co., Buffalo	10.00	9.00	5.58	4.00	2101
H-O Dairy Feed H-O Co., Buffalo	18.00	18.00	5.27	4.50	2100
Jersey Mixed Feed Indiana Milling Co	13.88	12.05	3.35	3.20	2186
Indiana Mixed Feed Unguaranteed. An adulterated bran	12.25 13.88	– –	4.30 –	– –	2102 2197
Dairy Mixed Feed Jennings & Fulton, Boston	11.13	12.05	3.00	3.20	2098
Protena Dairy Feed Purina Mills	17.38 17.25	20.00 20.00	4.72 –	3.50 3.50	2075 2171
Victoria Chop The Royce & Coon Grain Co	8.63	8.11	3.78	3.05	2199
Standard Middlings Washburn Crosby Co	17.19	18.00	6.36	4.00	2154
Hammond Dairy Feed Western Grain Products Co	11.69 15.88 17.15 14.69	17.00 17.00 17.00 17.00	4.34 6.52 – –	3.00 3.00 3.00 3.50	2020 2026 2037 2204
Haskell's Stock Feed W. H. Haskell & Co	9.25 9.25	10.00 10.00	7.38 –	6.25 6.25	2090 2152
Kaffir Corn Meal S. W. Thaxter & Co., Portland	10.38	–	8.36	–	2114

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Corn meal B. F. Parrot Co	8.50 8.56	– –	– –	– –	2129 2130
Gold Mine Mixed Feed American Cereal Co	13.94	–	–	–	2023
William Tell Mixed Feed Ansted & Burk	16.56 15.44 15.63 16.00	– – – –	– – – –	– – – –	2052 2096 2201 2203
King Feed A. P. Moore Milling Co	17.56	–	–	–	2202
Extra Fine Winter Mixed Feed Burns Bros	16.75	–	–	–	2149
Winter Wheat Bran Dorr & King, Pittsfield	14.31	–	–	–	2112
Vermont Mixed Feed Flint Milling Co	14.06 15.44 15.44 17.63 17.00	– – – – –	– – – – –	– – – – –	2024 2027 2056 2142 2191
Sunshine Mixed Feed Hunter Bros. Milling Co	15.88 15.75	– –	– –	– –	2148 2193
Mixed Feed Huron Milling Co	14.88	–	–	–	2008
Bran Jennings & Fulton, Boston, Shippers	14.69	–	–	–	2061
Flake Bran J. Hote & Sons, Lyons, Mich	13.88	–	–	–	2190
Mixed Feed J. Hote & Sons, Lyons, Mich	14.56	–	–	–	2192
Snowflake Mixed Feed Lawrenceburg Roller Mills Co	17.38	–	–	–	2147
Missouri Valley Mixed Feed Missouri Valley Milling Co	16.00 16.63	– –	– –	– –	2058 2145
Planet Spring Wheat Mixed Feed N. W. Consolidated Milling Co	15.06	–	–	–	2021
Pillsbury's Bran	15.06	–	–	–	2113
Pillsbury's XX Daisy Feed Flour	17.13	–	5.13	–	2135
Pyramid Mixed Feed Portland Milling Co	15.81 14.44 15.31	– – –	– – –	– – –	2022 2055 2151
Coarse Bran Washburn Crosby Co	16.63 15.00	– –	– –	– –	2006 2144

Analyses of Samples.

Name of Feed and Manufacturer or Shipper.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Louisville Mixed Feed; Washburn Crosby Co	16.00	–	–	–	2057
Winter Wheat Mixed Feed; Wm. A. Coombs	15.25	–	–	–	2141
Middlings; W. Stock and Son	16.63	–	–	–	2137
Phœnix Mixed Feed	14.50	–	–	–	2053
Beef Scrap; Armour & Co	58.00	–	23.55	–	2117
Bowker's Animal Meal; Bowker Fertilizer Co	47.38	30.00	10.35	5.00	2104
	34.75	30.00	–	5.00	2166
Bowker's Beef Scrap; Bowker Fertilizer Co	46.63	–	14.03	–	2063
Cornell Beef Scrap; Cornell Manufacturing Co	50.75	–	13.65	–	2065
Cypher's Beef Scrap; Cypher's Incubator Co	55.50	–	13.75	–	2064
Purity Beef Scrap; Geo. B. Haskell Co., Lewiston	63.25	60.00	12.62	5.00	2215
Dow's Beef Scrap; John C. Dow Co., Boston	45.63	50.00	26.90	15.00	2105
Beef Scrap; Portland Rendering Co	40.75	40.00	–	15.00	2001
	53.50	40.00	18.80	15.00	2081
	51.06	40.00	–	15.00	2103
	47.69	40.00	–	15.00	2160
Bone and Meat Meal for Poultry; Portland Rendering Co	42.25	40.00	12.10	8.00	2159

Discussion of the Results of Analyses.

However feeding stuffs may differ in their sources, they owe their value to certain constituents that are common to all of them. Feeding stuffs, like other foods, are of value in the animal economy for two distinct purposes. They build new tissues and serve as sources of energy for the performance of work, both within and without the animal body. The protein of the feeding stuff serves as building material. The starches and fats are of value as sources of energy which enable the body to do its work.

The average farmer should have no difficulty in growing all of the energy producing foods that he needs. Where a large number of animals, particularly dairy animals, are kept it is not usually practicable to grow all of the needed protein. While such crops as clover, peas, oats and other materials relatively rich in protein can be grown in sufficient amount to more or less completely supply the needs of the animals kept upon the farm, the protein supply must commonly be supplemented by the purchase of commercial feeding stuffs. Thus it usually happens that when the farmer goes to the market for the purchase of feeding stuffs, it is protein that he needs rather than starches and fats.

From the standpoint of the average feeder, protein is the most important measure of a commercial feeding stuff. While the energy producing carbohydrates and fats are just as important in the animal economy as is the protein, it is usually the case that the feeder does not need to buy the energy foods but needs to purchase protein. This constituent is determined in all samples collected by the inspector or sent to the Station by correspondents. The fats are not as important and in goods of the same class are more apt to run uniform than the protein, and for these reasons, the percentage of fat is usually determined only in one sample of each brand of goods analyzed. While on some accounts it is to be regretted that the funds for the feeding stuff inspection are so limited that only a partial examination of the samples collected is possible, for the most part this partial analysis serves the purpose fairly well. Occasionally in goods that are suspected of adulteration, it would be desirable to make much more extended examinations than is at present possible.

COTTONSEED MEAL.

Analyses pages 83 and 84.

Cottonseed meal is a by-product from the manufacture of cottonseed oil. After the cotton has been taken from the seed in the cotton gin, the remaining down or "linters" and the hard black seed coats or hulls are removed by machinery. The remainder of the seed is cooked and the oil expressed by high pressure. The resulting cottonseed cake is ground into the bright, yellow cottonseed meal of commerce. Such a meal made from good seed would carry from 40 to 50 per cent of protein. With improvements in the process of manufacture, it is now possible to extract the oil without making all the separations formerly needed. Hence it has come about that the cottonseed meal now offered in the market is as a rule of lower protein content than was the case ten years ago.

The shippers of cottonseed meal formerly guaranteed 43 per cent protein and 9 per cent fat. A large part of the cottonseed meal is used for fertilizing purposes and its nitrogen is guaranteed in the form of ammonia. Prime cottonseed meal from the Atlantic coast states, according to the classification of the Cottonseed Crushers' Association must carry not less than 7½ per cent ammonia. Seven and a half per cent ammonia is equivalent to 38.6 per cent protein; hence it follows that cottonseed meal now classed as prime need carry no more than 38.6 per cent protein. As the same association requires that prime cottonseed meal from the Gulf states must carry not less than 8 per cent ammonia, equivalent to 41.2 per cent protein, prime cottonseed meal as now coming into the market is sometimes guaranteed in accordance with the old standard of 43 per cent protein, while that from the Gulf states may be guaranteed 41 per cent protein and that from the South Atlantic states, 38.6 per cent protein.

The hulls and cotton which should be removed from the seed before it is crushed and pressed, have but little feeding value. A little of these materials has always been present in the meal; with the present processes of manufacture, there is probably more of these materials present than formerly. The demand from feeders for cottonseed meal has so increased the value of this by-product, that the temptation to include as much of the hulls and cotton as practicable is great. The processes of man-

ufacture in different mills also vary so that the meal from one mill will contain more of the dark hulls which gives the dark colored meal of inferior feeding value.

Strictly first-class cottonseed meal is always bright and yellow and should have a pleasant nutty flavor. Not all dark colored cottonseed meal is necessarily adulterated. The spontaneous heating of the seed in the field, or over cooking of the "meats" may render the meal dark in color without changing its composition. Such meal is not first quality, however, and should be sold at a lower price.

The hulls are lighter in weight than ground cottonseed cake and their presence in meal, particularly if they are not finely ground, can be readily detected by stirring a little of the meal in a tumbler with hot water. The hulls will settle out more slowly and will appear on the top of the meal in the bottom of the tumbler. Testing high grade meal in comparison with a poor meal will usually familiarize one with this simple yet quite reliable test.

With the exception of samples of cottonseed meal submitted by jobbers for the purpose of learning their quality, no cottonseed meal has been found in the State that was below the Cottonseed Crushers' Association standard for prime cottonseed meal. It will be noted, however, that none of the cottonseed meal has run above 45 per cent in protein and that most of it has carried about 40 per cent protein. The practical feeder can hardly count upon cottonseed meal carrying much more than 39 per cent protein and 8 per cent fat.

COTTONSEED FEED.

Analyses page 84.

Two samples of cottonseed feed, both from the D. L. Marshall Company were sent to the Station. These were approximately correctly guaranteed in their percentage of protein. Unless cottonseed feed can be bought for less than half the price of cottonseed meal, it is probably not an economical feed for Maine.

LINSEED MEAL.

Analyses page 84.

Linseed meal is made by grinding flax seed from which the oil has been more or less completely removed. Most of the oil meal now on the market is new process meal in which the fat is

extracted by the use of naphtha. New process linseed meal is somewhat lower in fat and higher in protein than old process. These goods, so far as sampled, are as guaranteed.

VISCID OIL MEAL.

Analyses page 84.

A sample of viscid oil meal sent by the manufacturers was found to analyze as follows: Water, 7.98 per cent; ash, 6.58 per cent; protein, 30.88 per cent; crude fiber, 11.86 per cent; nitrogen free extract, 37.67; fat, 5.03.

A sample taken in the open market the present year was found to carry 28.81 per cent protein and 11.63 per cent fat. So far as the composition is concerned, the goods seem to be of good feeding value. Of course a feeding test would be necessary to ascertain its true feeding value. Unless it can be bought at a much lower price than good linseed oil meal, it would seem to be wiser to use the linseed oil meal rather than the viscid oil meal.

GLUTEN MEALS AND FEEDS.

Analyses pages 84 and 85.

Gluten meals and feeds are the by-products left in the manufacture of starch and glucose from Indian corn. Corn consists largely of starch. The waste product in the manufacture of starch and sugar is relatively richer in oil and protein than is corn. Most factories remove part of the corn oil from the waste so that nearly all the gluten meals carry less oil than they did a few years ago.

Gluten feeds differ from gluten meals in that they contain considerably more of the corn bran and hence relatively less protein, fat and digestible carbohydrates, and more of the indigestible woody fiber. Gluten products which were formerly quite extensively used in Maine, continue to be rather unsatisfactory forms of concentrated feeds, chiefly because of their uneven composition.

Chicago gluten meal made by the Glucose Sugar Refining Company carries about 5 per cent less protein than its guarantee. The analyses of the Maine samples agree in the low protein content with those found in New York, Connecticut, Massachusetts and Vermont.

Jenks gluten meal is somewhat lower in protein than Chicago gluten meal, but contains more fat. It is incorrectly guaranteed so far as protein is concerned. The gluten feed made by Douglass & Company has 4 per cent less protein than guaranteed. Buffalo gluten feed is carrying approximately its guaranteed percentage of protein. The sample of Jenks gluten feed, guaranteed 27 per cent protein, very materially overrun the protein content; while Bay State gluten feed carried 5 per cent less protein than the guaranteed called for. Tiger gluten feed has no substantial agreement with its guarantee. Warner's gluten feed is about 2 per cent below guarantee.

It is unfortunate that the gluten feeds and meals are so irregular in their composition and that different makes vary so greatly. The gluten meals and feeds are desirable sources of protein and if the manufacturers placed proper guarantees upon their goods, there seems to be but little reason why this class of feeding stuffs should not become as popular as they were a few years ago.

DISTILLERS GRAINS.

Analyses page 85.

In composition, dried distillers grains resemble the gluten feeds. They are derived chiefly from corn from which the starch is removed by fermentation. They are more bulky than the gluten feeds and for the most part run higher in protein. A feeding test with distillers grains was reported in Bulletin 92 of this Station.

Two samples of Anchors distillers grains, guaranteed to carry 25 per cent protein and fat, were examined. These were very unusually low grade distillers grains. Biles Fourex continues to run in fair accordance with its guarantee.

Union grains are a ready made mixture carrying the protein and fat practically in accord with the guarantee. They are made up of distillers grains, gluten feed, ground corn, ground oats, and oil meal. For the farmer who must buy all his feed, Union grains at a fair price would probably prove profitable. As a rule, however, oats and corn are profitable for cows when the feeds are home grown and are expensive feeds to purchase. A

feeding test with Union grains was reported in Bulletin 106 of this Station.

MOLASSES FEEDS.

Analyses page 85.

Feeding experiments with molasses feeds have shown them to be fairly economical. They, however, are not used very much in this State and should not be purchased by the ordinary farmer since they are low in protein and high in carbohydrates. Feeders who find it necessary to purchase nearly all of their food may find these molasses feeds economical.

The one sample of the Molasses dairy feed of the American Cereal Company was lower in protein than the guarantee. The Molasses horse feed of the American Cereal Company and the Sucrene horse feed of the American Milling Company have practically agreed with guarantee in protein and fat. The Molasses dairy feed of the American Cereal Company ran nearly 2 per cent below its guaranteed percentage of protein. It is to be remembered, however, that this class of feeds are sold not as a source of protein but for the soluble carbohydrates which they contain, and the lower protein means more of the carbohydrates. Sucrene dairy feed has usually run well up to its guarantee. A lot sampled at Portland was found to be unusually low in protein and a second sample was drawn which carried nearly 3 per cent more of protein than the first, but both of them were low. The matter was taken up with the manufacturers and they were unable to explain the low protein content.

One sample of the Green Diamond sugar feed also ran considerably below its guaranteed percentage of protein. The makers explained this from the fact that an excess of molasses was used in its manufacture. In their letter they state that while this is not sold as a protein feed, they still desire to have the labels on the bags agree with the protein content of the goods, and will endeavor to keep the protein content fully up to the guarantee.

REFUSES FROM MILLING OATS, CORN, ETC.

Analyses pages 85 to 87.

The market still carries a large number of oat feeds, corn chops, corn and oat feeds and similar offals by themselves and

blended with concentrated feeds. They vary in composition from the straight oat hull refuse with perhaps 6 per cent protein, to the blends that carry from 15 to 18 or even higher percentages of protein. For the most part these goods are fairly well up to their guarantee and no fault can be found with the manufacturer for desiring to sell these waste products. Few or no claims are made for nutrients which the goods do not actually carry. The feeder has himself to blame if, with barns filled with hay, corn and silage, he buys feeds low in protein instead of those high in protein. An oat feed with 6 per cent protein is no better feed nor is it any better digested than oat straw with the same protein content. This class of feeds can probably be economically used only by feeders who find it necessary to buy "roughage" as well as concentrates.

The manufacturers have notified us that they have changed the minimum guarantee of protein of the Victor corn and oat feed from 9 per cent to 7½ per cent; the Quaker feed from 14 to 12 per cent; Schumacher's stock feed to 11 per cent; American poultry feed to 12 per cent protein; and Vim oat feed to 5.50 per cent protein. The guarantee of the Boss corn and oat feed has been changed to 8½ per cent protein and 3½ per cent fat; and on Friends oat feed the protein has been dropped from 8 to 7 per cent and the fat from 3 to 2.75 per cent; and the Royal oat feed is now guaranteed 6 per cent protein and 2½ per cent fat.

TRIANGLE CALF FEED.

Analyses page 85.

Chapin & Company's Triangle calf feed is claimed to be made entirely of different prepared grains without drugs or condiments, and is intended to be used the same for calves where milk is not available. The sample examined was up to guarantee.

PROTENA DAIRY FEED.

Analyses page 86.

Protena dairy feed continues to run considerably below its guarantee in protein content. Samples examined in Connecticut were found to carry 19 per cent protein. Of two samples examined in New Jersey, one carried 18 and the other 22 per cent protein.

WHEAT BRANS AND MIDDLINGS,—MIXED FEEDS.

Analyses pages 87 and 88.

The refuses from the milling of wheat vary, as is to be expected, quite largely in composition. A good quality of mixed feed or wheat bran should carry at least 15 per cent of protein and, as noted in the table, some of them run as high as 17 per cent. With the exception of the mixed feeds from Kentucky, sold under varying names, there seems to be no adulterated wheat bran or middlings upon the market. The Jersey mixed feed of the Indiana Milling Company, and the Indiana mixed feed and Dairy mixed feed of Jennings & Fulton are wheat bran, mixed with other refuses, chiefly corn cobs. Most of these goods offered in the State are properly tagged, carrying not only the percentage of protein and fat, but the statement of their composition, showing the foreign materials that have been added to the wheat bran. In two instances there was an attempt to evade the law by substituting for cob meal in one instance "corn *and* cob meal" and in another the phrase "crushed ear corn." When, however, the attention of the companies was called to this, proper labels were attached, so that most of the Indiana and similar mixed feeds are now labeled winter wheat bran, winter wheat ship stiff and corn cob meal. Unfortunately, however, there have been some instances in which the jobber, apparently, sold these adulterated goods for straight feeds. In the only instance, however, in which this fact can be definitely proven, there happened to be in the sample submitted an unusually small amount of corn cob so that the adulterated mixed feed carried only a little more crude fiber and but little less protein than a very poor straight wheat offal sometimes carries. On this account the case was not reported for prosecution.

There is no class of feeding stuffs in which the consumer needs to use greater care at present than in the purchase of mixed feeds. While the regular brands are all right, as they have been in the past, there are some spurious articles in the market. It is gratifying to report, however, that on his last tour, the inspector found no considerable amount of this class of goods in the hands of the dealers.

There is so much profit in selling ground corn cobs and broom corn at the price of wheat bran that the consumer must ever be

on the watch against this fraud. The safest thing is to buy only well known, reliable brands of this class of goods. The bulletin gives the names and analyses of many manufacturers of high class brans, and other wheat offals. If consumers will see to it that all of this class of feeds which they buy carries the name of the miller there will be little likelihood of their being defrauded. In case of any doubt, mail a sample to the Station and an analyses will be made and the results reported promptly and without any charge.

MEAT MEALS AND GROUND SCRAPS.

Analyses page 88.

The meat meals and ground beef scraps are used chiefly for feeding poultry and while they are very generally distributed, it is probable that the sales are not as large as some of the other materials coming under the feeding stuffs law. The guarantees placed upon the goods are only a very general guide to the actual composition. It will be noted that in several instances there are no guarantees accompanying the analyses of the samples, but this does not necessarily indicate the goods were not properly branded, as in some instances the samples were submitted by correspondents without the needed data.

In the table which follows, there is given the percentages of ash which were found in the beef scrap and similar materials here reported. The ash measures fairly well the percentage of bone contained in the goods. As the nitrogen in bone is not as valuable as that in meat, this fact should be taken into account in the purchase of beef scrap. Furthermore, the market price of meat meal is considerably higher than that of bone meal. Such a beef scrap as Armour's (No. 2117) which carries no more ash than ordinary meat, would be a much more economical feed than several others of the scraps and meals found in the table in which more than a third of their weight is ash. A meat meal carrying no more than 5 per cent of ash would have a much higher market and much higher feeding value than a meat meal with high ash content.

Ash in Beef Scraps, Meals, Etc.

Station number.	Brand.	Manufacturer.	Per cent ash.
2063	Bowker's Beef Scrap	Bowker Fertilizer Company	19.22
2064	Cypher's Beef Scrap	Cypher's Incubator Company	19.75
2065	Cornell Beef Scrap	Cornell Manufacturing Company	24.46
2081	Beef Scrap	Portland Rendering Company	22.68
2104	Bowker's Animal Meal	Bowker Fertilizer Company	35.46
2166	Bowker's Animal Meal	Bowker Fertilizer Company	42.98
2105	Dow's Beef Scrap	J. C. Dow Company, Boston	15.65
2117	Armour Beef Scrap	Armour & Company	3.91
2159	Bone and Meat Meal for Poultry	Portland Rendering Company	36.18
2215	Purity Beef Scrap	Geo. B. Haskell Company	11.08

Condimental Foods.

Although named in the law, the attorney general ruled that, since condimental foods are sold as medicines and not as food they do not come under the law.

Fortunately in the condimental foods offered, injurious drugs are not found. In addition to common feeding stuffs they consist for the most part of old-time simple remedies of mildly curative powers. The claims made for these materials are as ridiculously extravagant as those made for patent medicines designed for the use of man. The absurd testimonials used in their support are doubtless genuine, but are made by people who can not or do not understand the relations of cause and effect.

Facts to be Remembered.

The mixture of ingredients contained in the ordinary foods comprises all that are known either to practice or science as useful to animal life.

The ordinary cattle foods supply animal nutrition in the most useful and economical forms.

Condimental foods are absurd as medicines. If an animal is well no medicine is needed, if ill, remedies adapted to the case should be administered.

The farmer can manufacture his own "condimental" food at a fraction of their usual cost, by mixing a small amount of such common substances as salt, sulphur, saltpeter, fenugreek, cara-

way, etc., with the daily grain ration. This constant use of these "simples" is not recommended.

THE KIND OF CONCENTRATED FEEDING STUFFS TO PURCHASE.

The crops grown upon the farm are rich in carbohydrates and poor in protein. Clover will help supply the needed protein, and home grown grains will help out toward a balanced ration. But after growing all the food that can be produced economically on the farm, the dairyman will usually find that he needs to supplement the home grown food by the purchase of concentrated commercial feeding stuffs.

As the farm produces or can be made to produce all the starch, sugar and fiber that are needed, it is not necessary to take these constituents into account in the purchase of supplementary food materials. While they have a part, and a necessary part, in the ration, it is protein that is needed to supplement the home grown foods, hence the cost per pound of the protein in a given feeding stuff is of more importance than the ton price. A ton of cottonseed meal costs more than a ton of oat feed, but the protein in the former costs less than four cents a pound and ten or more in the other. The following table shows the number of pounds of protein that a ton of a few average feeding stuffs carries, and the cost of a pound of protein at the usual range in selling price.

Cost of one pound protein in different feeding stuffs at different prices per ton.

Kind of feeding stuff.	Protein in ton.	At $18 per ton.	At $20 per ton.	At $24 per ton.	At $26 per ton.	At $28 per ton.	At $30 per ton.
	Pounds.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Cottonseed meal............	840	....	....	....	3.0	3.3	3.6
New process linseed meal..	750	....	....	....	3.4	3.7	4.0
Old process linseed meal ..	640	....	....	....	4.1	4.4	4.7
Gluten meal	680	....	....	....	3.8	4.1	4.4
Gluten feed..................	520	....	....	4.6	5.0	5.4	....
Distillers grains	660	....	....	....	3.9	4.2	4.5
Union grains	480	....	....	....	5.4	5.8	6.2
Wheat middlings	360	5.0	5.4	....	....	....	....
Wheat bran	300	6.0	5.7	....	....	....	....
Oat feed as Vim or Royal ..	150	12.0*	....	....	....	....	....

*At $12 per ton, a pound of protein will cost 8 cents.

Weight of Different Concentrated Feeds.

It is the common practice in Maine to feed by measure rather than by weight, and since different feeding stuffs vary greatly in weight, it is obviously unfair to compare the feeding values of different feeding stuffs measure for measure. For instance, a quart of cottonseed meal weighs one and one-half pounds, and a quart of dried distillers' grains weighs less than half as much. To assist feeders who have no conveniences for weighing, the following table, prepared by Mr. H. G. Manchester, West Winsted, Conn., is reprinted from Bulletin 145 of the Connecticut Agricultural Experiment Station.

The average weight of one quart of each of the feeds named.

	Pounds.
Cottonseed Meal	1.5
Linseed Meal, old process	1.1
Linseed Meal, new process	0.9
Gluten Meal	1.7
Gluten Feed	1.2
Distillers' Grains	0.7
Wheat Bran, coarse	0.5
Wheat Middlings, coarse	0.8
Wheat Middlings, fine	1.1
Mixed Wheat Feed	0.6
Corn Meal	1.5
Hominy Meal	1.3
Oats	1.2
H. O. Dairy Feed	0.7
Victor Corn and Oat Feed	0.7

Figure 10. Laying and breeding houses at the Maine Experiment Station.

POULTRY EXPERIMENTS, 1905-6.

G. M. GOWELL.

[The poultry work of the Experiment Station was undertaken primarily to study breeding for egg production and has been in progress for several years. Two years ago the Bureau of Animal Industry of the U. S. Department of Agriculture desired to cooperate in the work and is now contributing $1,000 per year to assist in the carrying forward of the breeding experiments. Considerable unpublished data from these experiments have accumulated, but it has been decided to hold this matter for another year before it is published, at which time it will probably be issued as a bulletin of the Bureau of Animal Industry.

The following papers on poultry experiments have been published. These are no longer available for distribution. A summary bulletin bringing the work up to date has been prepared for the Bureau of Animal Industry and will be shortly issued by the U. S. Department of Agriculture. This can be obtained by addressing the Secretary of Agriculture, Washington, D. C.

- Number of Laying Hens that can be profitably kept in one Pen, Annual Report for 1898.
- Feeding Chickens for Growth, Bulletin 64.
- Breeding for Egg Production, Bulletin 64.
- Feeding Chickens for Growth, Bulletin 79.
- Experiments in Incubation, Bulletin 79.
- Breeding for Egg Production, Bulletin 79.
- Breeding for Egg Production, Bulletin 93.
- Floor Space, etc., in relation to Egg Production, Bulletin 93.
- Poultry Management as practiced at the Maine Station, Bulletin 100.
- Poultry Experiments, 1903-5, Bulletin 117.

This bulletin (130) in addition to containing accounts of experimental work, supplements bulletins 100 and 117 by outlining the methods of housing and handling the stock that have been adopted since these bulletins were issued.—C. D. W.]

The Incubator House and Poultryman's Residence.

Last fall the Station constructed an incubator cellar with a residence for the poultryman above it. The building is located conveniently near the poultry buildings and runs, and yet sufficiently removed to make it desirable as a residence.

Living so handy enables the poultryman to be in close touch with his work during the incubating and brooding season. While the incubators are in operation he inspects them at 5 o'clock in the morning and between 8 and 9 P. M. During the breeding period and while the chickens are on the range, it is desirable to have them liberated and fed as soon as they can see to eat in the morning, and not shut in at night until just before dark. This makes a long day for the caretaker, and the handy location of this house enables him to do his work more easily and satisfactorily.

The incubator cellar is 30 feet square, inside measurements, and 7 feet deep in the clear. Its walls are of concrete material and the floor is cemented. Two large cellar windows are in each of the west, north and east sides, but none on the south, as the warmth of the sun, admitted by windows in that side, would be liable to raise the temperature of the cellar during the middle of the day. The 6 windows give good light for caring for incubators and handling the eggs. Broad shutters darken the room when the eggs are being tested. The building has 2 chimneys and each has 2 separate flues. One flue in each chimney connects with the house fires and the other ventilates the cellar through adjustable openings. The chimneys being warmed by the up-stair fires cause the ventilating shutes to draw and ventilate the cellar quite well. In addition to these ventilators, the double doors in the rollway have openings 10 inches square with adjustable slides, and when necessary they are used to give complete ventilation. In the mornings, when the lamps are being cleaned and trimmed, and the out-of-door temperature is normal, both of the rollway doors are left partially open so as to quickly remove the odors of the lamps.

Thorough ventilation and a full supply of clean air to the incubator cellar are imperative. The incubator room is large enough to accommodate 16 of the largest size Cyphers incubators and leave space for passages between the machines for

caring for lamps, turning and testing eggs, and other necessary work.

The house is one story and has 4 good well finished rooms, with lavatory and closet, on the first floor, and a large unfinished attic on the second floor. A shed for fuel and storage extends in the rear of the building and shelters the rollway entrance. The outside aspect of the building and its surroundings are attractive.

Brooder Houses.

Portable brooder houses of several different sizes and styles of construction are in use, sufficient to accommodate 2,000 chickens to maturity. The houses which have proved most satisfactory are built on shoes so they can be drawn near together for convenience in the brooding season, during April, May and June, and then to the grass fields for the range season.

Each of the houses accommodates 125 or 150 chicks from the time brooding commences until they are moved into winter quarters. They are large enough so the necessary work can be done comfortably in them. During rainy days, when the birds must be kept indoors, there is room for them, and they will not suffer seriously if the floors are generously covered with cut clover or chaff. The birds in them are safe at night from storms, and all thieves that walk on four feet, crawl, or fly.

Such houses are almost indispensable to the person who raises few or many chickens. Their use removes many of the obstacles that tend to annoy and defeat the chicken raisers.

Each house is 12 feet long and 7 feet wide. The front wall is 6 feet 2 inches high, and the back 4 feet 2 inches high from floor to roof, inside. This allows a full grown person to stand erect in the front part of the house. The two shoes on which it is built are 4 by 6 inches in size and lie flat. Their ends are chamfered on the under side so as to give them a sled runner turn. They are 14 feet long, and extend a foot outside of each end of the building. An inch auger hole slanting backward, and outward, is bored through each end of the shoes. For convenience in moving the houses, a short chain with an eye bolt in each end, which can be slipped through the auger holes and keyed, is used.

The floors are of 2 thicknesses of boards, breaking joints so as to prevent the air from drawing through. The walls and

roof are boarded and the walls are covered with Red Rope Neponset, and the roofs with No. 2 Paroid Roofing material. A door 2 feet wide and 6 feet high is placed in the center of the front wall with a window on each side of it. Each window contains 6 lights of 10 by 12 glass in one sash. It is hinged at the top and turns out, like an ordinary storm window. It is either closely buttoned down, or held open at different spaces, by hooks of various lengths. The longest opening is a foot, which leaves the window slanting out at an angle sufficient to give plenty of fresh air in warm weather when both windows are open and the houses full of birds. The advantages of hinged, over sliding windows are, that in stormy weather, rains and winds do not beat in to wet or annoy the birds, and free ventilation is not interfered with. The windows are covered with wire netting on the inside. A slide door, a foot square, is made down at the floor, near each end of the front of the building, for the chicks to pass through. A temporary board partition about 15 inches high divides the building crosswise into halves. Two No. 4 Peep-O'-Day brooders are used in each of these houses. They are put about 2 inches away from the back wall so as to allow the free passage of air to the intake openings in the sides of the brooders. They set about a foot away from each end of the building, and this space is filled in with an elevated platform and incline, which allows the chicks to go out through the brooder door and down a broad easy grade to the floor.

The Peep-O' Day brooders are all made alike, with the lamp door at one side and the chick door at the other. They are located so that the lamp doors are towards the middle of the building and about 4 feet from each other, which gives about 2 feet between the lamp door and the temporary partition, sufficient room in which to attend to the lamps.

The hinges to the brooder cover are changed, so as to bring them at the back, which allows the cover to turn up against the back wall out of the way. These portable houses are well made, of good material, and if the shoes are kept blocked up from the ground, they should last as long as other farm buildings.

When they are drawn to the range for the warm season, they are turned back to the south, so that the sun may not shine in to the windows to heat the house and make it uncomfortable for the birds. Facing the north, the houses furnish good cool shelter during the heat of the day.

The houses which the pullets occupy are blocked up about a foot and a half and the open space between the house and the ground gives cool shelter which the birds enjoy. The pullets do not trouble about going under the houses to spend the night, but the cockerels do, and we find it necessary to board around the cockerel houses and deny them the cool retreat.

As the cockerels develop in September and October, they become quarrelsome and there are bullies among them, at every house, that domineer over their mates during the day, and stand guard at the doors at dark. With such fellows in the way it is difficult getting the underlings into the house at shutting up time at night, if they have a chance to skulk under the building.

Houses for Laying and Breeding Hens.

Two styles of houses are in use at the Station. One is a thoroughly made double walled building, 16 by 150 feet in size. It is always kept above freezing by a water heater and a flow and return, two inch pipe, running the length of the building. This building was constructed with especial reference to comfort, health and productiveness. Small well made houses with single walls had formerly been in use, but they would get white with frost in cold weather, if shut up close enough so the birds did not suffer from cold during winter nights. When the weather moderated, the white frost would change to water and the straw litter on the floor would become damp and clammy. The birds showed their dislike for the damp straw by keeping off from it as much as they could. Such houses were unsatisfactory, and so the large warmed house was built. It was a decided improvement over the cold ones, because it could be ventilated and the birds not suffer with the cold. But it was not possible to secure sufficient ventilation, even though the house was moderately warmed, to prevent the presence of considerable moisture in the bedding.

Good yields of eggs were obtained from hens kept in that house and the losses of birds were not excessive. The hens showed, however, that they were not in the best condition by a little lack of color in comb, and energy in action. This house has not been abandoned and is highly prized for laying hens. Since breeding cockerels cannot be carried in the other houses, without danger of chilled combs, they are wintered in this warmed house until danger from chilling is past.

In seeking for some better system of housing the birds one of the small close houses, formerly used, was changed into an open house. The building was 10 feet wide and 25 feet long. An opening 3 feet wide and 15 feet long was made close up under the plate, and was left open every day in winter, except when the snow or rain blew in. At night the opening was covered with a framed curtain made of cotton cloth. An elevated roosting closet along the entire length of the back of the building was made warm, by packing the walls with hay. A close fitting frame-cloth curtain shut them in at night.

It did not freeze in the closet and the birds apparently did not suffer for lack of air. They seemed to enjoy coming out of the warm sleeping closet, down into the cold straw, which was never damp, as the whole house was open to the outside air and sun every day. There were no shut off corners of the floor, or closet that were damp. This building was used through three winters with 50 hens in it each year and did not have a sick bird in it. Not a case of cold or snuffles developed from sleeping in the closet with its cloth front, and then going directly down into the dry straw, in the cold room, and spending the day in the open air.

The birds laid as well as did their mates in the large warmed house. Their combs have been red and plumage bright and they have given every evidence of perfect health and vigor. While they are on the roosts, in bed, they are warm. They come down to their breakfasts and spend the day in the open air. Such habits of life seem to work equally well with brute or man.

After having used this so-called Pioneer house one year, a house was constructed 12 feet wide and 68 feet long. Its front and back walls were 5 feet high and the roof was evenly divided. It was divided into 2 rooms, each 34 feet long. The elevated roosting closets extended along the entire backs of each room and they were constructed in the same manner as the one in the Pioneer house. The partition between the 2 rooms was made of 2 inch mesh poultry netting. There were 4 openings in the front of the building, 2 in each room, equal distances apart. Each opening was 3½ by 8 feet in size, fitted with frame cloth curtains, to be used only on winter nights and stormy days, in the same way that they were in the Pioneer house. These openings were put close up to the plates and came down to

within $1\frac{1}{2}$ feet of the floor. There were no glass windows in the building.

This house was not satisfactory. There were currents of air from one end of the building to the other, even when there was little wind outside, and when the wind was high in winter the loose snow would be sifted in and distributed over a large part of the floor, dampening the litter and making life uncomfortable for the birds. The wire partition between the pens was replaced with one of close boards, and conditions were bettered; but each of the pens still had 2 openings, about 8 feet apart, and the same troubles from currents of air and sifting snow continued, although somewhat lessened. One of the openings was closed by screwing glass windows on the outside. This left each of the rooms with one opening and one large glass window.

This change entirely corrected strong air currents through the building and sifting snow, except in heavy storms when the wind is strong from the south. Of course the large opening allows the wind to blow into the room, but as there is no outlet for it except where it came in, there are no drafts of air across the birds to cause them to be uncomfortable and take colds.

Another difficulty remained; the opening came down to within $1\frac{1}{2}$ feet of the floor, and the birds, sunning themselves on the floor or scratching in the litter, were in the direct course of the outside air as it came into the room and they tried to find sheltered corners where they might be more comfortable. On this account the width of the opening was reduced from $3\frac{1}{2}$ feet to 2 feet by ceiling up the lower part of it. This gave a bulkhead 3 feet high, sufficient to protect the birds on the floor from the direct inflow of out door air, and they were happy.

One objection to this house still remains; its front wall is too low to allow room for a large opening, high enough so that the sun can shine in and back across the floor to the back wall during the short days in winter, when the sun runs low. This feature in construction, seems to be of the utmost importance, for dependence is had upon the sunshine and pure outside air, to keep the floor litter dry and the elevated roosting closet clean. The entire front of the roosting closet being open, leaves no dark corners where the air and light cannot do their thorough cleansing.

Experience with the house showed its several bad features. On the other hand, the Pioneer house, which had been in use for

three years, gave great satisfaction, and the same general plan was adopted in the construction of a large house.

This house, designated as House No. 2, was built three years ago. It is 12 feet wide and 150 feet long and is divided into 20 feet sections. In each section, with its floor surface of 240 feet, 50 pullets have been wintered each year, most successfully.

Two years ago another house was built on the same plan, except that it is 16 feet wide instead of 12. It is 120 feet long and consists of 4 sections or houses, each 16 by 30 feet in size. There is no separate walk through the building, but in the close board partition, separating the pens, are doors, hung with double acting hinges, which allow them to swing both ways, and close automatically, after the attendant passes through. Each pen has a floor surface of 480 feet and gives ample accommodation to 100 hens. All of the hens in these two open front houses, in flocks of 50 or 100, averaged laying 144 eggs each last year, and the birds were in excellent health. The front curtains were open all of the time every day, except the very stormiest in winter.

While the same plan is common to all of these open front houses, the width has been increased in each succeeding one built. The first house was 10 feet wide, the second 12 feet, the third 16 feet in width. The laying and breeding house at Go-Well Farm, described on another page, is 20 feet wide and is more satisfactory than the narrower houses, because of economy in cost, and its greater housing capacity in proportion to its length, which reduces the labor required in caring for the birds, by having them in square rooms rather than in long narrow ones.

Additional Opportunities for Investigation.

The poultry plant at the Station is devoted to experiment and research work. There are many questions relating directly to commercial poultry operations, that are left untouched because the Station plant was already taxed to its capacity.

When the Go-Well poultry farm was established, last year, the opportunities were so good for studying poultry subjects on a purely commercial plant, where the entire energies of the place are devoted to this one business specialty, that arrangements were made with its owner which enables the Station to

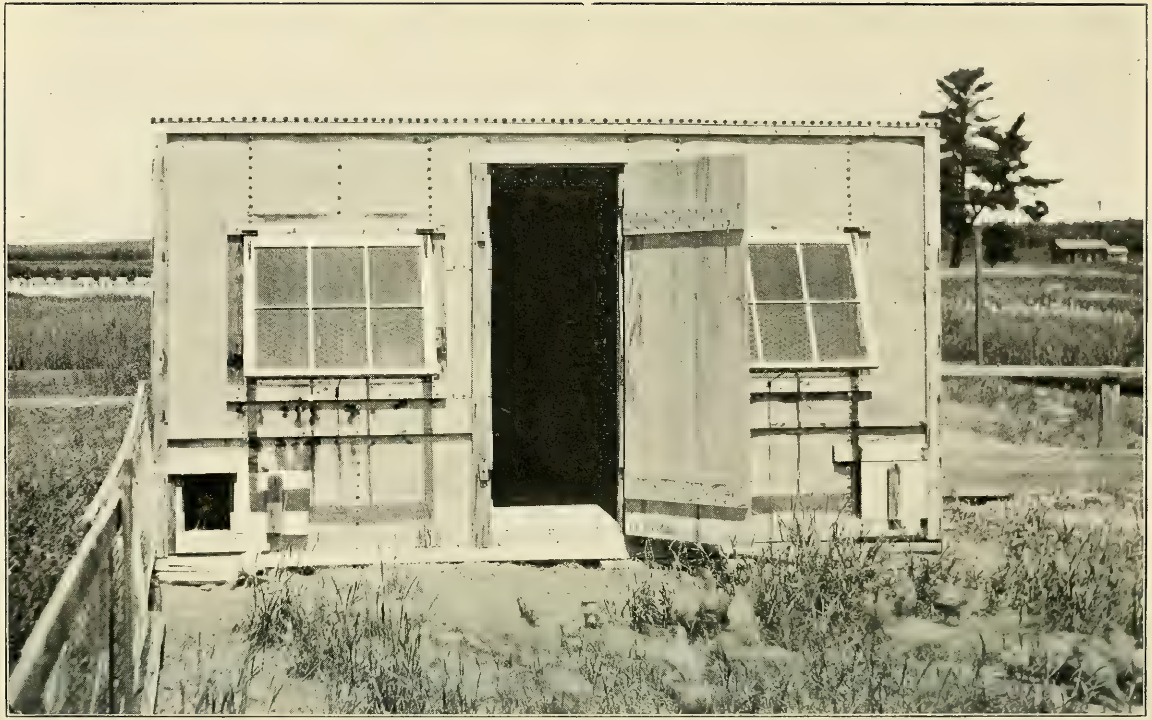

Figure 11. Movable brooder house. Described on page 103.

study the practical application of many of its own findings on an extensive, intensive business plant. Some of the results thus far obtained are made a part of the present bulletin.

GO-WELL FARM.

Of the hundred acres of land comprising the farm, thirty acres immediately at, and overlooking the village of Orono was fallowed and tilled for a year, then seeded to clover and grasses, in order to bring it into good condition for poultry farming.

The Barn and Incubator Room.

A barn of the Shrever plank frame pattern, 40 feet square, with 22 feet walls, was erected over a dry basement which has a heavy stone wall on 3 sides. The ground slopes away from the building on the east side sufficiently so that the large doors and windows in that side of the basement, open out on to receding ground, and renders the basement easy of access from a nearly level yard outside.

In addition to the 2 windows of 12 lights each, of 10 by 14 glass, in the east wall, the basement is lighted by 2 cellar windows in each of the 3 other sides. This gives a dry, well lighted room, 7 feet high and a little more than 36 feet square. It furnishes ample room for 24 of the largest Cyphers incubators, 5 or 6 barrels of oil, work tables and wide passages among the machines.

The windows on the exposed sides are shaded, when necessary, to protect from the warmth of the direct rays of the sun. During the spring months when the incubators are being used, the temperature of this room varies but little with changes in the weather outside. The first floor above the basement furnishes room for the storage of feed, machinery, appliances, and a general work room, while above it on the second floor, there was stored, last season, 40 tons of hay.

Brooder Houses.

There are 40 brooder houses built on shoes, so that they can be easily drawn about the farm to clean land when necessary. In size and construction, they are like the houses described under the heading,—Brooder Houses,—on pages 103 and 104.

In addition to the 80 Peep-O'Day brooders in these houses, there are 8 Cyphers out door brooders in use. Six thousand chickens are being raised this season (1906).

The Laying and Breeding House.

During the summer of 1905 a laying house was built to accommodate 2,000 hens. It is 20 feet wide and 400 feet long. It is on the same general plan as houses No. 2 and 3 at the Experiment Station. House No. 2 is 12 feet wide; house No. 3 is 16 feet wide, and this one is 20 feet wide. The widths have been increased in the last 2 houses, as experience has shown the advisability of it. At first it was thought the houses should be narrow so they might dry out readily, but the widest house dries out satisfactorily as the opening in the front is placed high up, so that in the shortest winter days the sun shines in on the floor to the back.

The economy in the cost of the wide house over the narrow ones, when space is considered, is evident. The front and back walls in the narrow house cost about as much per lineal foot as those in the wide house, and the greatly increased floor space is secured by building in a strip of floor and roof, running lengthwise of the building. The carrying capacity of a house 20 feet wide is 66 per cent greater than that of a house 12 feet wide, and it is secured by building additional floor space only. The walls, doors and windows remain the same as in the narrow house, except that the front wall is made a little higher. Three sills which are 6 inches square run lengthwise of the house, the central one supporting the floor timbers in the middle. They rest on a rough stone wall, high enough from the ground so that dogs can go under the building to look after rats and skunks that might incline to make their homes there. The stone wall rests on the surface of the ground. The floor timbers are 2 by 8 inches in size and rest wholly on top of the sills. All wall studs rest on the sills; the front ones are 8 feet long and the back ones 6 feet 6 inches long. The roof is unequal in width, the ridge being in 8 feet from the front wall. The height of the ridge from the sill to the extreme top is 12 feet 6 inches. All studding is 2 by 4 in size and the rafters are 2 by 5. The building is boarded with inch boards and papered and shingled with good cedar shingles on walls and roof. The floor is of two

Figure 12. Laying and breeding house at Go-well farm. See page 110.

thicknesses of hemlock boards, which break joints well in the laying.

The building is divided by tight board partitions into 20 sections, each section being 20 feet long. All of the sections are alike in construction and arrangement. The front side of each section has two windows of 12 lights of 10 by 12 glass, screwed on, upright, 2 feet 8 inches from each end of the room. They are 3 feet above the floor. The space between the windows is 8 feet 10 inches long, and the top part of it down from the plate, 3½ feet, is not boarded, but left open to be covered by the cloth curtain when necessary. This leaves a tight wall, 3 feet 10 inches high, extending from the bottom of the opening down to the floor, which prevents the wind from blowing directly on to the birds when they are on the floor. A door is made in this part of the front wall for the attendant to pass through when the curtain is open. A door 16 inches high and 18 inches wide is arranged under one of the windows for the birds to pass through to the yards in front. It is placed close down to the floor. A similar door is in the center of the back wall to admit them to the rear yard when that is used.

A light frame, made of 1 by 3 inch pine strips and 1 by 6 inch cross ties, is covered with 10 ounce white duck, and hinged at the top of the front opening, which it covers when closed down. This curtain is easily turned up into the room where it is caught and held by swinging hooks until it is released.

The roost platform is made tight and extends along the whole length of the room against the back wall. It is 4 feet 10 inches wide and 3 feet above the floor, high enough so that a person can get under it comfortably when necessary to catch or handle the birds. There are three roosts framed together in two 10 feet sections. They are one foot above the platform and hinged to the back wall so they may be turned up out of the way when the platform is being cleaned. The back roost is 12 inches from the wall, and the spaces between the next two are 16 inches. They are made of 2 by 3 inch spruce stuff, placed on edge, with the upper corners rounded off. The roosting closet is shut off from the rest of the room by curtains, similar to the one described above. For convenience in handling, there are two of them, each 10 feet long. They are 3 feet wide and are hinged at the top so as to be turned out and hooked up. The space above this curtain is ceiled up and in it are two openings each 3

feet long, and 6 inches wide, with slides for ventilating the closet when necessary. There is a door in every partition, placed 5 inches out from the edge of the roost platform. They are 3 feet wide and 7 feet high; they are divided in the middle, lengthwise, and each half is hung with double acting spring hinges, allowing them to swing open both ways, and close.

Ten nests are placed against the partition in each end of the room, in two tiers. They are of ordinary form, each nesting space being one foot wide, one foot high and 2 feet long, with the entrances near the partition, away from the light, and with hinged covers in front for the removal of the eggs. Each section of 5 nests can be taken out, without disturbing anything else, and cleaned and returned. In constructing the house it was designed to use these nests only the present year. The framework where they rest was arranged for the use of trap nests, the intention now being to install them at the end of the present year, in October.

Troughs are used for feeding the mixtures of dry meals, shell, bone, grit and charcoal. The bottoms are made of boards 7 inches wide; the ends being of the same width and 18 inches high. The back is of boards and the cover is of the same material and slopes forward sufficiently so the birds cannot stay on it. A strip 5 inches wide is nailed along the front edge of the bottom to make the side of the trough. Pieces of lath are nailed upright on the front, 2 inches apart, between which the hens reach through for the feed. A thin strip 2 inches wide is fastened to the front of the trough at an angle of about 45 degrees to catch the fine meal that the birds pull out and would otherwise waste. They clear it up from this little catchall and so waste is mostly prevented.

Two lines of 4 by 4 inch spruce are arranged as an elevated track above the doors. The track extends the entire length of the building and being faced with narrow steel bands on top, a suspended car is readily pushed along, even when heavily loaded. The platform of the car is 2 by 8 feet in size and is elevated a foot above the floor. All food and water are carried through the building on this car. The 10 iron baskets, into which the roost platforms are cleaned every morning,, are put on the car and collections made as the car passes through the pens to the far end of the building, 400 feet away, where the roost

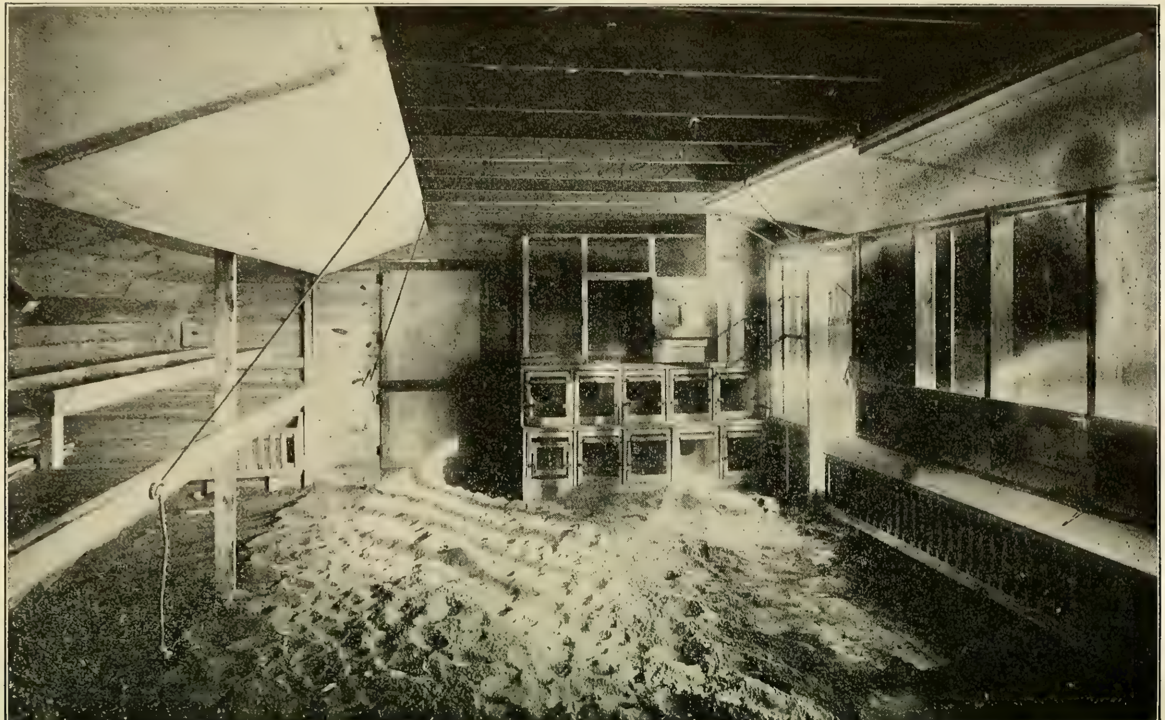

Figure 13. Interior of one section of curtain front house.

cleanings are dumped into the manure shed. As the car is pushed along, the guard at the front end comes in contact with the doors and pushes them open and they remain so until the car has passed through, when the spring hinges force them to close again. This car is a great labor saver as it does away with nearly all lugging by the workmen. It has enabled one man to take good care of the 2,000 hens from November to March, except on Saturdays, when the litter has been removed and renewed by other men.

At one end of the building there is a temporary food and water house for dish washing and scalding and where the car remains when not being used.

There is a walk outside of the building extending along its entire front. It is 4 feet wide and is made of 2 inch plank; it is elevated 2 feet above the floor of the building, which allows the doors, through which the birds pass to the front yards, to be opened and closed without interference. The door which opens out of each room through the curtain section, is above the outside walk and necessitates stepping up or down when passing through, which is not a very serious objection, as the door is used but little in the daily work, but mostly in cleaning out and renewing the floor litter. A guard of wire poultry netting, a foot wide along the outside of the walk, prevents the birds from flying from the yards up to the walk. The advantages of the elevated walk, over one on a level with the sill of the building is that it is unobstructed by gates, which would be necessary were the low walk used, to prevent the birds from passing from one yard to another.

The yards conform in width to the 20 foot sections of the house and are 100 feet deep. The fence is 5 feet high and is made from 2 strips of 2 inch mesh No. 19 poultry netting. By using 2 strips of 30 inch width, instead of one strip of double that width, 2 strong lines of wire are brought in the middle and the liability of bagging is much lessened, while the cost is not increased.

To give free passage for teams, to near the door of the building, openings 12 feet wide are left in the yard fences. They are 15 feet away from the front of the building, so that the road may not be obstructed by the snow which is liable to accumulate near the building. The frame fence sections, which fill in the openings during the summer, are quickly taken out and replaced

on cleaning days, and the delivery of bedding and worn litter back and forth, from wagon to buildings, is very directly made.

Yards, similar to those in front, will be constructed in the rear of the building and by alternating their use it is hoped to keep them clean, and more or less covered with green plants.

Packing and Shipping House.

A house 20 by 24 feet in size was made, in which to handle and pack the eggs for market. Its walls are packed with planer shavings, to prevent too great changes in temperature during extreme weather. It is well heated and lighted. The eggs are expressed to market when not more than one day old. The express company takes the shipments at the house daily and returns the emptys.

Residence of Foreman.

A neat four-room cottage house, finished and painted, was built for the foreman and his family. It has long distance telephone connections and in this way the foreman is within reach of the owner at all times.

Every building on the plant is new, having been constructed for the special purpose of poultry business. The equipment is also entirely new and uniform, only one kind and size of incubators, and one kind of indoor brooder being used, which relieves the operators of the annoyances which arise from the use of different kinds of machines.

Investigation Relating to Breeding to Increase Egg Production in Hens.

In 1898 the Maine Agricultural Experiment Station designed and constructed fifty trap nests and put them in use by the pullets kept that year. From time to time, the work has been extended until now 200 trap nests are in use by a thousand hens.

By the trap nest it is possible to know the exact daily work which every hen is doing. At the end of the year those that had laid 160 eggs, or over, were selected and saved for breeders. They were bred to males whose mothers had laid 200, or more, good eggs per year. No female has been used in the breeding pens, for six years, whose mother did not lay at least 160 eggs in her pullet year. No males have been used as breeders unless their mothers laid above 200 eggs per year. The breeding pens

are now filled with birds of both sexes, that have six generations of mothers and fathers before them, that were bred under these rigid rules of selection.

The stock commenced with in 1898 had been laying about 120 eggs each per year for several years, as shown by the flock records. During the last two years, the hens have averaged 144 eggs each, during their pullet year. There seems to be reason to conclude that the producing capacities of the hens have been increased by about 2 dozen eggs per year. Perhaps this increase is not all due to the selection and breeding. The dry feeding and open air housing, doubtless, have contributed to the improvement. But, reason about it as one may, the fact remains that not a drone or small producer, backed only by beauty of form, feature, or color has had a place in the breeding of these birds in any of the last 6 generations.

The purpose of this work must not be misunderstood. The attempt is not to produce a stock of birds that shall average to produce 200 eggs per year. If by continued work a family of birds can be permanently established that with reasonable treatment, will yield 12 dozen eggs each per year in flocks of 100, it will be a matter of great consequence to the poultry industry. These yields are already being obtained in the Station flocks. There is no reasons why the stock should not yield as well in other hands, but in order for succeeding generations of birds to do so, it will be necessary to at least use male birds whose breeding has been based on performance.

The question is frequently asked if the stock is not likely to be weakened by inbreeding, since male birds are not purchased from outside flocks. There is no reason to go outside for fresh blood. This season there are 82 hens in the breeding pens, each of which has yielded 200 to 251 eggs in a year. The different matings made with so many birds makes easy the selection of only distantly related males and females when making up the breeding pens. The number of the breeding birds carried makes easy the avoidance of inbreeding, and this is strictly guarded against, as it is doubtful if the inbred hen has sufficient constitution to enable her tc withstand the demands of heavy egg yielding.

During only one season, and then with but two small pens, have birds as closely related as first cousins, been bred together. Line breeding is followed; the matings being only with distantly

related birds. The birds are vigorous, of good size, and able to stand up under hard work. They have good, large, yellow legs and yellow beaks. They are well feathered and barred, but they are not bred for the fanciers or the show room, although there are many fine specimens in the yards.

As evidence that the function of heavy egg yielding has become fixed in the stock, attention is called to the fact that many male birds have been sent out to farmers and breeders in this, and other states, with which to improve the egg yields of their flocks. The many voluntary statements, from the purchasers, telling of the early and heavy egg yields from the pullets gotten by these cockerels, is substantial testimony to the utility of the stock; and added to the known average increase of 2 dozen eggs per bird for the hens in the Station flocks argue well for the breeding.

Other Methods of Selecting Breeding Stock.

The only reliable method of selecting breeding stock is by aid of the data secured by the use of trap nests. It is, however, only investigators, large operators, and breeders who make a business of producing birds and eggs for breeding purposes, for sale, who can afford the equipment and expense of operating trap nests. Most poultrymen and farmers who carry small flocks are usually too busy to give the regular attention required by any reliable and satisfactory trap nest. They can better afford to buy the few males required each year from some one who makes breeding stock by trap nesting a specialty.

There are one or two concerns that advertise to teach how to pick out the pullets that are to be good layers, and how to pick out the hens that have laid well. The price for the system is $10 by one of the concerns, with a bond of $1,000 to keep the secret. The warm friends of both systems tried them on some pens of trap nested birds at the Station with known records, and both parties went away sorrowing at the results of their work. Their systems were unknown to the writer but it does not matter, for both were completely valueless as applied here.

Two others came to show that it was not necessary to use trap nests. One claimed to be able to tell the laying capacities of pullets by the positions of the pelvic bones; while the other was sure he could tell the yields for the coming year, to within 8 or 10 eggs, by the length and shape of the toe nails. Another was

sure that large combs are infallible indications of great egg laying capacities.

There are 80 birds in one yard at the Station each one of whom has laid from 200 to 251 eggs in a year. So far as can be discovered, they differ from each other sufficiently to upset any theory of selection thus far put forward. One feature is common to all these hens. They all have strong constitutions.

EARLY MATURITY INDICATIVE OF GOOD LAYING.

A year ago last August and September, 29 pullets were selected on the range that were laying in the brooder houses, or about commencing doing so, as shown by their red combs, and their prating and following the caretaker about the field, talking about the things they were going to do, in true hen language, which is easily understood and not to be mistaken, by any one who knows chickens. These young birds were carried into the laying house, banded, and given the regular treatment for laying hens. Records were kept with each individual for 365 days forward from the day on which each one gave her first egg.

Four birds died during the year, and the 25 remaining averaged laying 180 eggs each. Two of the 4 that died had done good work; one having laid 148 eggs up to July 30, and the other 150 up to April 7. Eight of the 29 birds laid over 200 eggs each. The only poor layers in the lot were two of those that died; one laying 58 to March and the other 113 to June.

The average production of all the pullets kept in the regular work last year was 144 eggs per bird. The average of 180 made by this lot, and the small number of poor yielders in it, show the advantages of selecting the early layers for breeding purposes. Those selected were of the most forward pullets.

To the farmers and small poultrymen who do not use trap nests, this plan of selecting the breeding females has much to commend it. The method is simple. There is no secret about it. It is just common sense. Such pullets, bred to males, purchased from some reliable breeder, who practices trap nest selection of his breeding stock, ought to improve the egg yielding capacities of the flocks.

The table shows the individual records of these pullets, during the 365 days following the recording of their first eggs; and it also shows their yields up to the end of October,—the regular time of closing the year's records.

This list includes all of the birds that were put into the test; showing those that died as well as those that continued through the year.

Records of early maturing pullets.

Number of hen.	Date on which the first recorded laying was made.	Number of eggs laid during the first 365 days.	Number of eggs laid to October 31, 1905.
1	September 1, 1904	153	180
2	September 1, 1904	143	167
3	September 20, 1904	142	162
4	September 1, 1904	190	223
5	September 20, 1904, died July 30	148	....
6	September 20, 1904, died March 20	58	....
7	September 10, 1904	185	226
8	September 10, 1904	188	221
9	October 1, 1904	204	218
10	October 10, 1904	162	171
11	September 6, 1904	139	150
12	September 25, 1904, died June 24	113	....
13	October 1, 1904	182	198
14	September 1, 1904	137	160
15	September 1, 1904	170	199
16	October 1, 1904	208	229
17	September 1, 1904, died April 7	150	....
18	September 1, 1904	158	177
19	September 1, 1904	185	222
20	September 6, 1904	160	163
21	September 10, 1904	190	222
22	October 1, 1904	210	228
23	October 1, 1904	201	209
24	September 8, 1904	217	251
25	October 1, 1904	205	210
26	September 1, 1904	212	248
27	September 1, 1904	239	265
28	September 1, 1904	145	171
29	September 12, 1904	178	199
	Average of 25 birds for 365 days	180	....

Growing the Chickens.

The chicks are allowed to remain in the incubator until they are about 48 hours old. They are then strong, steady on their legs and hungry.

The temperature under the brooder hover is kept between 95 and 100 degrees during the first week; reducing it about 5 degrees during each of the next three weeks. Great care should be exercised that the floor of the brooder does not get too warm. After they are 3 or 4 days old, they are taught, little by little, the road down, and out on to the floor, which is covered with half an inch of sand and an inch or two of dry cut clover, or clover leaves and chaff.

The best method of feeding young chicks is at present a matter of some uncertainty. Many different kinds of food and different ways of feeding give good results.

One condition appears to be imperative and that is, that the young things, until they are at least three weeks old, be not allowed to overeat. We have guarded against this by watching them closely and examining their crops for emptiness just before feeding time. This enables them to eat 4 good meals a day and be hungry at feeding time. Where regular full meals are given them they are allowed at the troughs only a short time. A long drawn out meal to enable them to clean up the dishes impairs their digestion, and ruin follows.

Where small broken grains and meals are kept constantly within reach of the young things, either in the litter or small troughs, the crops never appear to be empty, neither are they ever crammed full as they are when fed at regular hours, and yet the birds live well and seem to thrive when they are within easy reach of food all of the time.

At the present time the Station is studying young chick feeding closely, for it is the most difficult feature of the whole poultry industry. We can now give no better method than that practiced in raising the chicks during this and the last season, because by it few birds have been lost and good thrift has been secured.

Infertile eggs are boiled for half an hour and then ground in an ordinary meat chopper, shells included, and mixed with about 6 times their bulk of rolled oats, by rubbing both together. This mixture is the feed for 2 or 3 days until the

little things have learned how to eat. It is fed sparingly, in the litter and sand, on the brooder floor.

About the third day, they are fed a mixture of hard, fine broken grains, i. e., cracked corn, wheat, millet and pinhead oats, as soon as the birds can see to eat in the mornings. This is fed in the litter, care being taken to limit the quantity so they shall be hungry at 10 o'clock. Several of the prepared dry chick foods have been tested. They are satisfactory when made of good, clean grains without grit. The grit and charcoal can be supplied at less cost and must be freely provided.

At 10 o'clock the rolled oats and egg mixture is fed, in tin plates with low rims. After they have had the food before them 5 minutes the dishes are removed and they have nothing to lunch on, except a little of the fine broken grain which they scratch for. At one o'clock the hard grains are again fed, as in the morning, and at 4.30 to 5 o'clock they are fed on the rolled oats and egg mixture, giving all they will eat until dark.

When they are about 3 weeks old, the rolled oats and egg mixture is gradually displaced by a mixture made up of 2 parts by weight, of good clean bran, 4 parts corn meal, 2 parts middlings or red dog flour, 1 part linseed meal and 2 parts screened beef scrap. This mixture is moistened just enough with water so that it is not sticky, but will crumble, when a handful is squeezed and then released. The birds are developed far enough by this time so that the tin plates are discarded for light flat troughs with low sides.

The hard broken grains may be safely used all the way along and the fine meals left out, but the chicks do not grow so fast as when the mash is fed. There seems to be least danger from bowel looseness when the dry grains only are fed, and it is very essential that the mash be dry enough to crumble, in order to avoid that difficulty. Young chicks like the moist mash better than though it was not moistened, and will eat more of it. There is no danger from the free use of the properly made mash, twice a day, and being already ground the young birds can eat and digest more of it, than when the food is all coarse. This is a very important fact and should be taken advantage of, at the time when the young things are most susceptible to rapid growth. But the development must be moderate during the first few weeks. The digestive organs must be kept in normal condition by the partial use of hard

foods, and the gizzard must not be deprived of its legitimate work and allowed to become weak by disuse.

By the time the chicks are 5 or 6 weeks old, the small broken grains are discontinued and the 2 litter feeds are wholly of screened cracked corn and whole wheat. Only good clean wheat, that is not sour or musty, should be used.

FINISHING THE BROILERS.

When the chickens are about 9 or 10 weeks old, and the cockerels weigh a pound and a quarter to a pound and a half, the cockerels are put by themselves, into vacated brooder houses, 100 to a house. Each house has a yard in front, about 12 feet square. They are fed on porridge, 3 times a day, in V-shaped troughs, with 4-inch sides. The porridge is made of 6 parts corn meal, 2 parts middlings, ½ part linseed meal and 2 parts beef scrap. Not having milk, it is mixed with tepid water. It is made thick enough so it will drop and not run, from the end of a wooden spoon. They are given all they will eat in half an hour, when the troughs are removed and cleaned. When the yards get dirty, they are bedded down with sand, straw or hay. The birds will stand this feeding for 2 or 3 weeks with good appetites. When they commence taking less food they are dressed for market and usually weigh about 2¼ pounds dressed weight.

FOOD AND OTHER MATERIAL REQUIRED TO GROW CHICKS TO BROILER SIZE.

To make broiler raising most profitable, warmed houses should be used and the birds raised early enough to be all marketed while high prices are obtainable.

The Station does not make a specialty of broiler raising. The chickens are raised so as to obtain the pullets for egg laying. The surplus cockerels are disposed of by growing them rapidly and getting them off to market before they annoy the pullets. As the cockerels and pullets are raised together, and the cockerels only are finished and sold as broilers, it is not possible to state just how much of the food given to the flock has been eaten by the cockerels, as they were larger and evidently ate more per bird than the pullets did. The quantities of food eaten, aside from labor, have been accounted

for, in the work, and the records show that when the chicks that were hatched in April and May were 11 to 12 weeks old, the cockerels weighed about 2¼ pounds, dressed for market. Up to this time the cockerels and pullets had each averaged to eat 9 pounds of grain food, 1 pound of beef scrap and ¼ pound of grit.

When the cockerels average 2¼ pounds dressed weight, the pullets of the same age averaged 1¾ pounds, and as there were equal numbers of cockerels and pullets in the lot, the average weight of all the birds at that time was 2 pounds. Five pounds of the grain and meat foods were required to produce a pound of dressed broiler, under the described conditions and practices.

The material used in the production of a 2-pound broiler cost as follows:

10 lbs. of food..................	16.5 cents.
Oil for incubating and brooding..	2.5
Eggs incubated	4.0
Total	23 cents.

The labor involved in raising the chick and preparing it for market is not accounted for. The average prices received for each 2-pound broiler last June was 60 cents; July 50 cents, and August 40 cents.

DEVELOPING THE PULLETS.

When the cockerels are taken out for finishing, the pullets of the same age are moved to the grassy range, still occupying the same portable houses in which they were raised. At this time the method of feeding is changed, and dry food is kept by them constantly, in troughs with slatted sides and broad detachable roofs, so it may not be soiled or wasted. The troughs are from 6 to 10 feet long, with the sides 5 inches high. The lath slats are 2 inches apart and the troughs are 16 inches high from floor to roof. The roofs project about 2 inches at the sides and effectually keep out the rain except when high winds prevail.

The roof is easily removed by lifting one end and sliding it endwise on the opposite gable end on which it rests. The

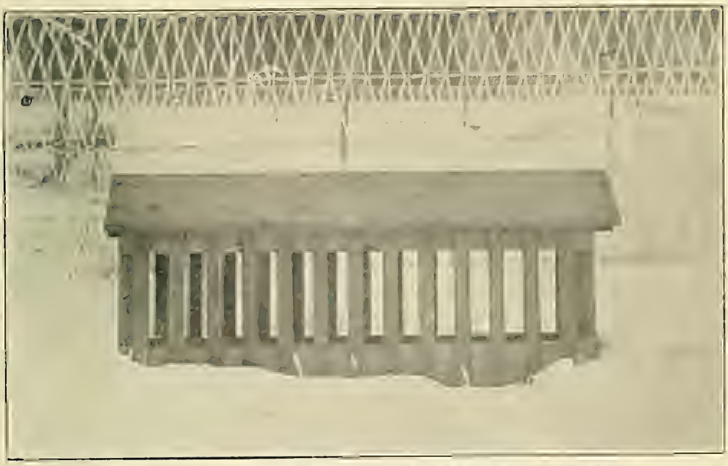

Figure 14. Dry feed trough with sliding roof.

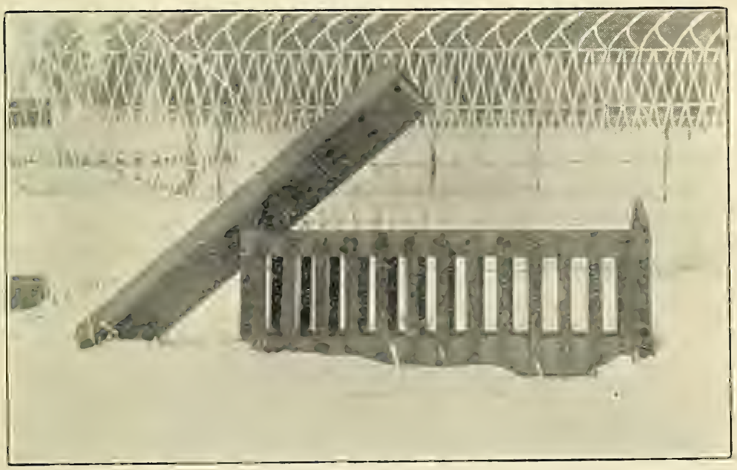

Figure 15. Dry feed trough with roof removed. Described on page 122.

trough can then be filled and the roof drawn back into place without lifting it. This arrangement is the best thus far found, for saving food from waste and keeping it in good condition. When dry mash is used in it there may be considerable waste by the finer parts being blown away. When used for that purpose it is necessary to put it in a sheltered place out of the high winds.

In separate compartments of the troughs, they are given cracked corn, wheat, oats, dry meal mixture, grit, dry cracked bone, oyster shell and charcoal. The dry meal mixture is of the same composition as that fed to the laying hens, described on page 125. The troughs are located about the field in sufficient numbers to fully accommodate all of the birds.

The results of this method of feeding are satisfactory. The labor of feeding is far less than that required by any other method followed. The birds do not hang around the troughs and over-eat, but help themselves, a little at a time, and range off, hunting, or playing and coming back again, when so inclined, to the food supply at the troughs. There is no rushing, or crowding about the attendant, as is usual at feeding time, where large numbers are kept together.

For the last 7 years we have gotten the first eggs when the pullets were from 4 months and 10 days, to 4 months and 20 days old. There is some danger of the pullets getting developed too early, and commencing laying too soon for best results, under this system of feeding. In order to prevent such conditions, the houses should not be located too close to each other, or to the feed troughs, and a large range should be given them so they may be induced to work, which they will do, if given the opportunity early after their removal to the fields. Should the birds show too great precocity, and that they are liable to commence laying in August, the supply of cracked corn in the feeding trough is reduced, or taken away altogether, which causes them to eat the wheat, oats and dry meal instead, and they continue to grow and develop without getting too fat and ripe.

During the last days of October it is our practice to move the pullets into the laying house.

COST OF PULLETS RAISED FOR LAYERS.

Last season 2,000 pullets were raised for layers and the following materials were used in producing each one:

28	pounds of	grain, meal and scrap, costing..	44.5 cents.
¾	"	cracked bone	1.5
½	"	oyster shell	.25
2¼	"	Mica Crystal Grit..............	1.25
½	"	charcoal	.5
1½	pints of oil	....	2.5
2	eggs	....	4.0
			54.5 cents.

Before they were moved into winter quarters, many of them were laying in the brooder houses, and the eggs from them at that time had sold for a hundred dollars.

Feeding the Hens.

For many years warm mashes made from mixtures of different meals, sometimes with the addition of cooked vegetables, were given to the hens every morning during the winter season and in warm weather mashes of similar composition but mixed with cold water were fed. The hens seemed to like mashes made in this way better than anything except corn, and if fed anywhere near enough to satisfy their appetites, they would load themselves with food and then sit down in idleness durng the early part of the day. They were not willing to scratch in the floor litter for the wheat, oats and cracked corn that had been buried there for them.

The losses of hens from what appeared to be the system of feeding, caused the change of the time of feeding the mash, from morning until near night, and giving the cracked corn, wheat and oats, in the litter, in the morning and near noon.

These changes resulted in the better health and productiveness of the birds, but the crowding for the mash at feedng time and the hurried filling of their crops to repletion even near bed time, did not argue for the best.

Several different plans of feeding were compared by testing them for a year and finally the moist mash was abandoned altogether. The present system of feeding has been practiced

here for two years and is regarded as the best method thus far used. The dry meal mixture is composed of the same materials, in the same proportion as the moist mash was, but the method of feeding it is different. It is kept within reach of the birds at all times, but they never stuff themselves with it, either because they do not fear an exhaustion of the supply by their competing mates, or else it does not taste so good to them as to cause them to eat of it to repletion. Yet they appear to eat enough of it. It is rich in the materials from which hens make eggs. Hens that lay many eggs must be generously nourished. In the changes in feeding made here, it was not the quantity or composition of the ration that was altered, but the feeding habits of the birds.

It is not proven that our present system for feeding is the only correct one. Some other methods may be better, but at the present time it is giving excellent satisfaction with Plymouth Rocks.

DRY FOODS ONLY.

Early in the morning for each 100 hens, 4 quarts of screened cracked corn are scattered in the litter, which is 6 or 8 inches deep on the floor. This is not mixed into the litter, for the straw is dry and light and enough of the grain is hidden so the birds commence scratching for it almost immediately. At 10 o'clock they are fed in the same way, 2 quarts of wheat and 2 quarts of oats. This is all of the regular feeding that is done.

Along one side of the room is the feed trough, with slatted front. In it is kept a supply of dry meals mixed together. This dry meal mixture is composed of the following materials, viz.:

200 lbs. good wheat bran,
100 lbs. corn meal,
100 lbs. middlings,
100 lbs. gluten meal or brewers' grain,
100 lbs. linseed meal,
100 lbs. beef scrap.

These materials are spread on the floor in layers one above another and shoveled together until thoroughly mixed, then kept in stock, for supplying the trough. The trough is never allowed to remain empty. The dry meal mixture is constantly

within reach of all of the birds and they help themselves at will.

Oyster shell, dry cracked bone, grit and charcoal are kept in slatted troughs and are accessible at all times. A moderate supply of mangolds and plenty of clean water is furnished. About 5 pounds of clover cut into inch lengths is fed dry, daily to each 100 birds, in winter. When the wheat, oats and cracked corn are given, the birds are always ready and anxious for them and they scratch in the litter for the very last kernel, before going to the trough where an abundance of food is in store.

It is very evident that they like the broken and whole grains better than the mixture of the fine, dry materials; yet they by no means dislike the latter, for they help themselves to it, a mouthful or two at a time, whenever they seem to need it, and never go to bed with empty crops, so far as noted. They apparently do not like it well enough to gorge themselves with it, and sit down, loaf, get over-fat and lay soft-shelled eggs, as is so commonly the case with Plymouth Rocks when they are given warm morning mashes in troughs.

Some of the advantages of this method of feeding are that the mash is put in the troughs at any convenient time, only guarding against an exhaustion of the supply, and the entire avoidance of the mobbing, that always occurs at trough feeding, when that is made the meal of the day, whether it be at morning or evening. There are no tailings to be gathered up or wasted, as is common, when a full meal of mash is given at night. The labor is very much less, enabling a person to care for more birds than when the regular evening meal is given.

The average amounts of the materials eaten by each hen during the last year are about as follows:

Grain and the meal mixture.....	90.0 pounds.
Oyster shell	4.0 pounds.
Dry cracked bone..............	2.4 pounds.
Grit	2.0 pounds.
Charcoal	2.4 pounds.
Clover	10.0 pounds.

These materials cost about $1.45.

The hens averaged laying 144 eggs each.

SUCCULENT FOODS AND CLOVER.

Succulent foods are supplied to all birds, each day throughout the year. The double yards allow the birds to gather green grass, young oats, rye or rape for themselves during the growing season, as they are turned from the worn run to the fresh ones, when the supply of green plants is eaten off. If the sod is much broken, or the plants injured so they will not spring up and cover the surface with green again, the vacated yards are cultivated and reseeded heavily.

When buildings are new and the runs are fenced in from land with a good sod on it, the yards may last a year or two without the sod being used up, but unless they are large, it will soon be necessary to cultivate and reseed, if they are depended upon to furnish green food. The yards, 20 by 100 feet, are large enough so that there is room for a single horse to work comfortably in them. It is questionable whether it might not be more economical to construct only single yards for exercise, and feed the hens daily on green food, which could be raised on rich land, handy by. Probably less labor would be required to raise the green food in the fields than in the yards, but the labor of cutting and carrying it to the birds would be considerable.

For green food during winter and spring mangolds are used. They are liked by the birds and when properly harvested and cared for remain crisp and sound until late spring. They are fed whole, by sticking them on to projecting nails, about a foot and a half above the floor. Care must be exercised in feeding them, as they are laxative when used too freely. On the average about a peck per day to 100 hens, can be safely used. They would eat a much greater quantity if they could get it.

A 4 months' feeding test, extending from January 1 to April 30, 1906, in which mangold wurzels were compared with cut clover, has just been completed. Two lots of hens, each consisting of 100, were kept under similar conditions, both lots being fed as described on page 124, except that one lot had about 17 pounds of mangolds each day and no clover; while the other lot received no mangolds, but were given 5 pounds of clover leaves and heads, gathered from the feeding floor in the cattle barns. Both lots of birds had new beds of

oat straw every week. The 100 birds eating the mangolds averaged laying 63.9 eggs each, during the 4 months. The 100 birds eating the clover, averaged 59.6 eggs during the same time. The slight difference between the yields of the two lots can hardly be regarded as indicating greater value for the mangold ration.

The vigor and apparent healthfulness of the two lots were equally good. In the general feeding both mangolds and clover are used daily. Formerly it was thought necessary to steam, or wet the clover with hot water in order to get good results from it. It is now cut and fed dry, in the bottom of cement barrels, cut off about ten inches high. About 5 pounds are eaten daily, by 100 hens, with very little waste. Apparently as good results are gotten from it as when it was scalded; the labor of preparation being very much lessened.

Time Required to Establish Fertility in the Eggs of Hens When First Mated.

Fifty Barred Plymouth Rock hens, one year old, that had been laying well throughout the preceding winter and spring, and had been kept away from male birds since they were 12 weeks old, were mated with cockerels and their eggs incubated, to determine how soon after introducing male birds into pens of virgin hens, the eggs may be sufficiently fertilized for incubating purposes.

Table showing the results of incubating the eggs from 50 hens during the first 7 days of mating.

	Number of eggs laid.	Infertile.	Weak development.	Strong development.	Chicks hatched out.
June 23	17	17	....	....	......
June 24	23	13	7	3	......
June 25	21	7	1	3	10
June 26	18	7	3	4	4
June 27	31	6	4	4	17
June 28	32	4	7	5	16
June 29	26	5	3	3	15

Three cockerels were put into the pen at 6 A. M. June 23 and the eggs collected and marked at 9 A. M., 12 M., 3 P. M. and 6 P. M. during that and the days following.

Incubation showed all eggs laid June 23 to be entirely infertile. Three eggs collected at 9 A. M. June 24 showed weak fertility. Four eggs collected at 12 M. of that day showed weak fertility, and two eggs collected at that hour were so strong in fertility that the embryoes in them developed to about the eighteenth day. In a previous test, reported in Bulletin 79 of this Station, two chicks were hatched from the eight eggs laid on the second day of mating.

On June 25th, the third day the birds were mated, they laid 21 eggs and from them 10 chicks were hatched out. The fourth day of mating did not show as good results, the 18 eggs yielding but 4 live chicks. During the fifth day of the mating, the 50 hens laid 31 eggs and they yielded 17 chicks. On the sixth day they laid 32 eggs and 16 chicks were hatched out, and on the seventh day the 26 eggs laid, yielded 15 chicks.

These results show that the eggs laid during the days immediately following the fourth day of mating, yielded rather more than 50 per cent of good chicks, which is about the percentage usual in the general incubation work here, which, however, is done earlier in the season, when conditions are supposed to be not as favorable.

Hatchability of the Eggs from the Same Hens During Ten Consecutive Months.

One of the most annoying and perplexing features of poultry work is the large number of eggs incubated, which do not yield chicks. Formerly when the hens lived in warm houses in winter and part of their food consisted of moist mashes, sometimes not more than a fourth of their eggs yielded live chicks. For the last 2 years the average of chicks hatched from the eggs laid by the hens in February and March, has been at the rate of one chick to about 2 eggs, and for those laid during April, less than 2 eggs have been required to yield a chick.

It is hoped that means may be devised by which the present wastes may be reduced, even where chicks are raised in large numbers. In order to study the hatchability of the eggs from the same lot of hens, through their first laying year, a pen

of 50 pullets was set apart for the purpose. They were hatched late in May and commenced laying in October, continuing laying moderately, through November and December. The 50 birds were mated in November with 2 cockerels, that did not quarrel, and these matings continued through the 10 months test.

Three of the 50 died and did not do a full years' work, and 7 others laid irregularly and are not considered in the data given below.

The hatchability of eggs from the same forty hens each month from January to October.

Number eggs laid during each month.		Number eggs laid and incubated during first ten days of each month.	Results of incubating the eggs, as shown in percentages of the numbers incubated each month.			
			Per cent chicks hatched out.	Per cent infertile or slightly started.	Per cent in which development stopped by 12th day.	Per cent in which development stopped by 20th day or failed to get out of shell.
January	390	129	26	29	23	22
February	629	152	24	26	28	21
March	870	190	37	42	7	14
April	704	201	61	27	9	2
May	607	120	39	27	12	22
June	524	137	41	26	9	17
July	505	153	58	15	8	19
August	410	138	54	29	6	12
September	464	131	52	27	8	13
October	249	91	35	44	8	13

During the first 10 days in January, all of the eggs laid by the 40 birds were saved and incubated and the results noted. The same was done through the first 10 days of each succeeding month, ending with October. All of the eggs laid during the several 10-day periods, were incubated, none were rejected because of lack of size, irregular shape, or defective shells, as would have been done in ordinary selection. This, of course, reduced the percentages of hatchable eggs in all the periods. The results are given in the accompanying table.

The most impressive feature of the table is the per cent of chicks hatched from the July, August and September eggs. The hens had averaged laying 16.6 eggs each, per month, for the 5 months ending with June. July and August were warm months; the egg yields were lessened, and many of the birds were in partial moult, yet the eggs of July yielded 58 chicks per hundred, and those of August, 54 chicks. From this test there appears no support of the theory, that long continued laying reduces the chick-producing capacities of the eggs.

Every egg in the experiment was marked as laid, and its behavior in the incubator noted. Perhaps the data secured from the pen of 40 hens, considered collectively, is as valuable as though the histories of each hen's eggs were traced, individually for the 10 months.

The Effects of Long and Short Matings upon the Chick-Producing Capacities of Eggs.

As a matter of convenience for many years past our breeding pens have been made up in November. The expense and difficulties of providing roomy pens for the cockerels, separate from the hens, have been the reasons for so doing. It has been easy to see, when the two sexes have been together for several months, that the hens have suffered from the too constant attentions of the cockerels. They have given evidence of this by their somewhat worn condition and loss of feathers from backs and necks, as compared with their sisters, in other pens, where there were no cockerels. The egg yields were no less in the mated, than in the unmated pens, and to appearances the eggs were of as good size in one class as the other.

However that may be, it has been a mater of serious question whether the eggs laid by hens that had been mated so long, with cockerels that had 3 or 4 months' service, were in as good condition for chick yielding as those from freshly mated males and females.

On the first of last November, 15 pens of pullets were set apart for breeding purposes. The birds were hatched between April 1st and May 14th, and had not been with cockerels since they were 12 weeks old. Nine of the pens were mated November 25th by putting 6 cockerels into each pen of 100 pullets. They all ran together and mated at will, until February 24th, when the 6 cockerels in each pen were divided into 3 lots, of

2 each. Each lot of 2 cockerels was allowed in turn a half day's freedom, one lot being shut up, and another lot liberated at noon and night, each day. When not at liberty, each 2 cockerels were in coops, 2½ by 6 feet in size, in company with about half the broody hens of the pen. The coops were light and the birds on the floor were in plain sight of the prisoners at all times.

The other 6 pens of females were kept separate from the males until February 24th, when they were mated with brothers of the cockerels employed in the 9 pens described above. The cockerels and pullets in the 6 pens were fresh, never having been in service. The 6 cockerels assigned to each pen were divided into lots of 2, and each lot given their liberty, alternately, just as they were in the first 9 pens.

The saving of the eggs for incubation was begun March 2, 6 days after regular mating commenced. The eggs were saved from each lot until March 17th, when they were incubated under similar conditions. From the pens where the males and females had run together all winter, 3,240 eggs were incubated and 1,529 chicks hatched out, an average of about one chick from 2⅛ eggs. From the pens where the males and females had not been together until the breeding season commenced on February 24, 2,160 eggs were incubated, and 1,075 chicks hatched out,—an average of two eggs being required to yield one chick.

These slight differences in results should not be interpreted as meaning that there are advantages in the short, over the long matings, for so small differences are liable to show in any pens of birds, however treated. Much more marked differences in results would be needed, to indicate that the running together of both sexes, at will, during several months prior to the breeding season, is detrimental to the chick-producing capacities of the eggs.

While the results of this test may not be convincing, the 1,500 birds employed and the large number of eggs incubated, with the satisfactory average yields of a chick from 2 eggs, does furnish data sufficient to remove scruples regarding the fitness of long-mated birds for breeders.

INDIAN CORN AS A FOOD FOR MAN.

L. H. MERRILL.

Among the benefits which accrued to civilized man through the discovery of the New World, the acquisition of Indian corn must be considered as one of the greatest. Its excellence seems to have quickly impressed itself upon the early settlers, and the history of the American Colonies was from the first closely identified with this grain. Since corn is not only a native of the Americas but has been cultivated by the Indians and natives of Central and South America for 20 centuries or more, it is not strange that it was found to be admirably adapted to the climate and needs of this quarter of the globe. The alacrity with which it was adopted by the settlers was in itself sufficient tribute to its excellence. It seems to have been the only food plant cultivated by the Indians, and so exclusively was it grown that the word corn, which formerly signified any cereal food grain, soon lost its original meaning and came to be applied exclusively to Indian corn, although the wider use of the word is still retained in England. It was a long time before this grain ceased to be the most important of our food cereals; indeed, it is scarcely a century since wheat has assumed the leading place to which its superior bread-making qualities entitle it.

Although Indian corn now occupies the second place in importance among the cereals which in this country serve as food for man, it far exceeds wheat in the size and value of the crop produced. In 1611 the James River settlement had 30 acres of corn under cultivation. In 1621 the Massachusetts Bay colony boasted 20 acres devoted to the same crop. In 1905 there were in the United States 94,000,000 acres in corn, and the crop attained the almost incredible size of 2,707,993,540 bushels, with a value of $1,116,696,738. In the same year 47,854,079 acres were given up to wheat, and the crop was 692,979,489 bushels, worth $518,372,727. The acreage of corn

was double that of wheat, and the value of the crops was in about the same proportion.

It is difficult if not impossible to grasp the full significance of such figures as these. Perhaps the imagination might be assisted by supposing the whole State of Maine one immense corn field. It would require more than 4 such fields to equal the area mentioned. If the product of this vast tract were put in bushel baskets, and these baskets could be arranged in a line upon the equator, allowing 18 inches to a bushel, the line would extend around the earth 30 times, and would furnish 30 bushels of grain to every man, woman and child in the United States.

Of course but a small fraction of this amount is utilized as human food. There are no reliable statistics to show how much is thus consumed, but it is doubtful if it exceeds one bushel in 50 of the total crop. Its use today is much more general in the South than in New England, where for the most part it is eaten only at irregular intervals as brown bread, johnny-cake, or occasionally as hominy. The colonists, following the example of the Indians, ate parched corn, either entire or in the form of a coarse meal. The virtues of this latter preparation, known as "nocake," have been highly extolled, and it seemed to fill the high position now occupied by the predigested cereal breakfast food. Other dishes which found favor with the colonists, composed wholly or in part of corn, were hominy, hasty pudding, johnny-cake, brown bread, pone, samp and succotash, the last consisting of green corn cooked with beans. Although wheat has so largely replaced corn, it may be questioned whether we can not profitably make a fuller use of the cereal which seemed to conduce to both the physical and intellectual vigor of our forefathers.

Relative Composition of the Cereal Grains.

A statement of the comparative value of our foods requires the use of certain terms which may be briefly explained here.

Protein. Under the general name protein we include a number of bodies all of which contain nitrogen and most of which belong to the class known as proteids. These bodies possess a peculiar value in that they are absolutely necessary in our foods and cannot be replaced by any other class of compounds, although they may themselves replace to a large extent the fats

and carbohydrates. The fleshy part of the animal body consists largely of protein which can be formed only by the protein of the food. Hence the protein bodies are frequently spoken of as "flesh formers." As examples of protein may be mentioned the gluten of wheat, the curd of milk, and the white of eggs.

Fats or ether extract. Nearly all our foods contain a variable amount of fats and oils. These are readily soluble in ether which is usually employed in the chemical laboratories to remove these bodies. Since the ether also dissolves other bodies which may be present in small quantities, the term "ether extract" is frequently employed as a more exact term, though the shorter term "fats" is often used as being the more convenient. While these bodies possess great value as foods, they may be dispensed with, since the animal is able to form fats from both protein and carbohydrates. Fats are most abundant in the animal kingdom, although very few vegetable foods are entirely free from them.

Carbohydrates. These bodies are by far the most abundant in the vegetable kingdom, the amounts in our animal foods being too small to call for notice. The term includes the sugars and starches and also the woody matter of plants, or cellulose. The sugars are very readily digested as are the starches when properly cooked. The cellulose in the older plant tissues is not easily digested by man. This hardened cellulose constitutes the "crude fiber" of the chemist. The term nitrogen-free extract is often used to denote all the carbohydrates less the crude fiber.

Heat of combustion. The protein, fats, and carbohydrates, so far as they are digested, are all oxidized or burned in the animal body with the production of heat and body energy. The protein is not fully oxidized in the body, but produces, pound for pound, as much heat and energy as the carbohydrates. The fats are the greatest heat producers, yielding weight for weight, 2¼ times as much energy as the protein or carbohydrates. The heat of combustion of a food material is the heat produced by its oxidation. The energy thus developed is measured by calories, a calorie being the amount of heat required to raise one kilogram of water through one degree C., or about one pounds through four degrees F.

The *ash or mineral matter* of a food is what remains behind after the oxidation is complete. Being already fully oxidized it can furnish no energy, although the ash constituents may be absolutely essential to the animal.

In the table below is given the average composition of the principal cereals used for food. The analyses are quoted from Bul. 13, Part 9, Bureau of Chemistry, U. S. Department of Agriculture. With the exception of the rice, the analyses represent American grown grains.

Average composition of cereal grains.

	Water.	Protein.	Fat.	Crude fiber.	N-free extract.	Ash.	Heat of combustion.*
	Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.	Cal. per lb.
Barley, unhulled	10.85	11.00	2.25	3.85	69.55	2.50	1735
Indian corn	10.75	10.00	4.25	1.75	71.75	1.50	1799
Oats, unhulled	10.00	12.00	4.50	12.00	58.00	3.50	1791
Rice, hulled	12.00	8.00	2.00	1.00	76.00	1.00	1716
Rye	10.50	12.25	1.50	2.10	71.75	1.90	1743
Wheat	10.60	12.25	1.75	2.40	71.25	1.75	1750

* Calculated.

From an inspection of the table it will be seen that of the six cereals considered, corn ranks fifth in the amount of protein which it contains, carrying only about four-fifths as much protein as wheat. On the other hand, with the single exception of oats, it contains far more fat than the other cereals and two and one-half times the quantity found in wheat. It is comparatively poor in fiber and ash, but leads in the heat of combustion, a fact that is due to the large proportion of fat which it carries.

Since the cereals are purchased for the most part in the form of flours or meals, comparisons based upon the relative composition of these products would be more valuable than those just made. In most of the digestion experiments carried out at this Station, Pillsbury's Best flour and a granulated corn meal have been used. In the following table the composition of these materials is compared with that of the original corn, with hominy, and also with meal prepared by the old process, still used in some sections of the country.

Average composition of corn products used in digestion experiments compared with wheat flour.

	Water.	Protein.	Fat.	Carbohydrates. Crude fiber.	Carbohydrates. N-free extract.	Ash.	Heat of combustion.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Cal. per lb.
Corn	10.75	10.00	4.25	1.75	71.75	1.50	1796
Hominy	10.96	9.44	.67	.37	78.24	.32	1808
Corn meal, unbolted......	10.30	7.50	4.20	65.90		1.20	1544
Corn meal, bolted	11.60	8.40	4.70	74.00		1.30	1728
Granulated meal..........	11.79	8.50	.98	.46	77.79	.48	1734
Granulated meal..........	7.77	8.69	1.92	.40	80.72	.50	1825
Wheat flour	11.09	11.37	1.33	.13	75.44	.64	1771

The corn meal formerly found upon the market consisted merely of unbolted ground corn, the composition of which was practically identical with that of the grain from which it was prepared. Such meal was commonly sifted before it was used, the bran and other coarse particles being thus removed. While such meal may still be found upon the market, being extensively used as food for stock, that used as a food for man is generally bolted before the meal leaves the mill, the offals or bran being sold as cattle food. Since the fat or oil, so abundant in corn, is confined largely to the germ, and since the oil is peculiarly subject to changes resulting in rancidity, the presence of the germ is predjudicial to the keeping qualities of the meal. This has lead to the production of the so-called granulated corn meal, obtained by the use of roller-mills. Instead of reducing the kernel to the desired fineness by a single operation, it is first crushed by a machine known as a degerminator which so loosens the germ and hull that they may be removed before the final grinding. It is evident that the composition of the product thus obtained will differ in several very important respects from that previously described, being poorer in fat, through loss of the germ, and also poor in crude fiber or woody matter, which

is found for the most part in the rejected outer coating or the bran. These differences are well shown in the above table. In the manufacture of hominy the germ is also removed, with marked effect upon the proportion of fat in the product. It will be noted that in the manufacture of both hominy and granulated corn meal two-thirds or more of the ash constituents are removed. While small amounts of these salts play a very important part in the animal economy, there is reason for believing that the most of our foods carry them in such large excess that the removal of a part of them in this case is no cause for uneasiness.

Digestibility of Corn Products.

The statement has been made that corn meal is less digestible than wheat flour; that our forefathers ate corn rather than wheat from necessity, and digested it because they could; whereas the present less stalwart generation digests corn less readily, and finding a better cereal at hand is wise in eschewing the first. As a part of the work of the nutrition division of the Office of Experiment Stations a number of digestion experiments with corn have been carried out at this Station. The reader is referred to a later publication of that office for details of this investigation. Only the general results with a brief outline of the methods employed are given here. The experiments were performed with human subjects, and were continued for periods of 6 days each. During this period each subject received daily weighed amounts of food of known composition. The feces corresponding to the food eaten were collected and analyzed. In similar experiments with cattle it is usually assumed that the difference in composition between the food and the feces proceeding from the same represents that part of the food which is utilized in the body; in other words, that the feces consist only of undigested food. In point of fact, this is not strictly correct, since we know that the feces consist not only of undigested food, but contain also small amounts of waste matters resulting from the natural wear of the body together with certain secretions, known to the physiological chemist as metabolic products, which have found their way into the intestines and have not been entirely reabsorbed, and which thus contribute to the volume of the feces. Sometimes, espec-

ially when the amount of food eaten is small, the error thus introduced is too large to be ignored, particularly in the case of the protein. Several methods have been devised for correcting this error so far as it affects the protein, and such a correction has been applied in the results quoted beyond.

The corn products used in these experiments were hominy and granulated corn meal. The first was cooked in the usual manner and was eaten in one experiment with cream and sugar, in another experiment with a mixed diet, including bread, meat, canned peaches, butter, and sugar. The corn meal was eaten in the following forms: 1. Hasty pudding. 2. Johnny-cake. 3. Brown bread. 4. Hoe-cake. The hasty pudding was prepared by stirring the meal into salted water and cooking in a double boiler. In both johnny-cake and brown bread equal weights of meal and flour were used. The formulas used follow:

Formulas for johnny-cake, brown bread and hoe-cake.

	Johnny-cake.	Brown bread.	Hoe-cake.
	Grams.	Grams.	Grams.
Corn meal	100.0	100.0	100.0
Flour	100.0	100.0	....
Salt	5.0	4.0	5.0
Sugar	10.0	....	5.0
Baking powder	4.4	4.4	....
Molasses	....	40.0	....
Water	....	....	400.0
Milk	150.0	200.0	....

The brown bread was steamed in tin cans made for the purpose, somewhat conical in form, and provided with covers. Four loaves were cooked at once, the cans being immersed to half their depth in boiling water in a large pan having a perforated false bottom and a cover with a small opening. The loss by evaporation was very small, and the process, once in operation, required no further attention during the 4 hours allowed for the cooking.

Neither flour or baking powder were used in the preparation of the hoe-cake. The hot meal was stirred with boiling water until a thick pudding was formed, which was then spread in thin sheets upon the hot, well-greased iron plates and baked at once. In all the work care was taken to insure thorough cooking.

Average composition and heat of combustion of the corn meal and white flour breads used in the digestion experiments.

	Water.	Protein—(Nx625).	Ether extract.	Carbohydrates. Crude fiber.	Carbohydrates. N-free extract.	Ash.	Heat of combustion.
FRESH.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Cal. per lb.
Johnny-cake	29.4	7.8	2.2	.2	57.5	2.9	1384
Brown bread	43.9	6.3	2.1	.1	45.7	1.9	1119
Hoe-cake	52.8	4.0	.6	.2	40.0	2.4	886
White flour bread	40.7	6.9	.3	.1	49.8	2.2	1135
WATER-FREE.							
Johnny-cake	....	11.3	3.0	.3	81.3	4.1	1960
Brown bread	....	11.1	3.7	.2	81.7	3.3	1994
Hoe-cake	....	8.4	1.2	.4	84.9	5.1	1874
White flour bread	....	11.7	.4	.1	84.1	3.7	1914

The compositions of the breads eaten is shown in the above table. It will be noted that the breads vary greatly in the proportion of water which they contain, with a less marked variation in the other ingredients. When these analyses are reduced to a water-free basis, as shown in the second part of the table, these differences become very much less. Thus, the dry matter of the johnny-cake has almost exactly the same composition as the dry matter of the brown bread, a fact that is not surprising when it is remembered that nearly the same formulas are used for both.

A wide difference in the protein contents between these breads and the white flour bread might have been looked for, since wheat flour is much richer in protein than corn meal. That so slight a difference exists must be attributed to the use of white

flour and milk in the preparation of the johnny-cake and brown bread, while the white bread was mixed with water. The hoe-cake carries much less protein than the other breads, neither white flour or milk being used in its preparation.

Since the differences in water content and the other differences resulting therefrom actually exist in the foods as eaten, the composition of the fresh materials is, after all, the matter of first importance. As eaten, the hoe-cake possessed only about two-thirds the food value of the johnny-cake and brown bread, while the last mentioned was distinctly inferior to johnny-cake in the amounts of nutrients which it contained. In practice it was found that the quantities of bread required and eaten were inversely proportional to the water content.

Several of the digestion experiments reported on the following pages were made with 2 subjects and most of them with 4. The results given in the table are the average of those thus obtained. With all the corn products a double series of trials was made, one with a "simple" the other with a "mixed" diet. In the case of the hominy and hasty pudding the simple diet consisted of the products named with milk and sugar as accessory foods. With johnny-cake, brown bread and hoe-cake, butter was used in addition to the above. The mixed diet included meat and canned peaches. The men enjoyed excellent health throughout the investigation, and while the diet at times proved monotonous, they retained good appetites throughout the experiment.

The results of these experiments are given in the table on the following page. The digestibility of the protein is shown in the first two columns, in the second of which corrections for metabolic products have been applied, as explained on page 138. While it is not claimed that the method adopted for this purpose gives absolutely correct results, there can be no doubt that the corrected figures furnish a more accurate idea of the food value of these materials, and in the discussion which follows these results only will be considered.

Digestibility of nutrients and energy of total food.

	Protein.		Carbohydrates.	Heat of combustion.
	Not corrected for metabolic products.	Corrected for metabolic products.		
	Per cent.	Per cent.	Per cent.	Per cent.
Hominy, simple diet	83.6	89.2	99.0	96.4
mixed diet	88.9	93.6	98.8	96.3
Hasty pudding, simple diet	82.3	89.2	99.0	95.9
mixed diet	89.0	94.0	98.9	96.9
Johnny-cake, simple diet	89.6	94.9	98.7	93.8
mixed diet	90.1	94.8	99.3	93.9
Brown bread, simple diet	87.4	94.7	98.7	93.5
mixed diet	89.5	95.5	99.4	92.9
Hoe-cake, simple diet	87.0	93.9	98.7	93.7
with syrup	84.4	92.6	99.2	95.5
mixed diet	90.0	94.6	98.8	92.6
White bread, simple diet	89.2	94.0	98.9	94.0
mixed diet	92.6	96.1	99.0	98.2

Discussion of the Results Obtained by the Digestion Experiments.

1. In every case but one, the protein of the mixed diet was more completely digested than that of the simple diet. The low digestibility of a simple diet has been often noted in previous experiments.

2. With a simple diet the protein of the johnny-cake and the brown bread seems to have been slightly more digestible than that of the white bread. With the mixed diet, the white bread shows a digestibility distinctly greater than that of the corn breads.

3. The use of syrup with the hoe-cake to a slight degree depressed the digestibility of the protein. This is in accordance with other experiments in which the digestibility of the protein apparently varied with the ratio existing between the protein and the other nutrients.

In this connection attention may be called to the large proportion of carbohydrates in the food used in this work. The requirements of the body seem to be most economically met by

a selection of foods supplying protein, carbohydrates, and fat in certain proportions, although the two latter classes of nutrients may replace each other to a considerable extent, a pound of fat supplying about as much energy as 2¼ pounds of carbohydrates. The proportions generally accepted as well adapted for an average person of active habits are one of protein to 5 or 6 of carbohydrates or the equivalent in fat. The proportions as found in the food of these experiments are shown in the table below.

Ratio between the protein, carbohydrates, and fat of food, one part of fat being considered as equivalent to 2¼ parts of carbohydrates.*

	Simple diet.	Mixed diet.	Simple diet with syrup.
Hominy	1:13.1	1:6.8	
Hasty pudding	1:11.8	1:7.3	
White bread	1:8.8	1:6.0	
Johnny-cake	1:8.3	1:6.9	
Brown bread	1:8.5	1:6.9	
Hoe-cake	1:9.7	1:6.9	1:15.4

*This is not quite the same as the "nutritive ratio" of stock feeders, which is based upon the digestible nutrients only.

With the simple diet, consisting largely of corn relatively low in protein, the ratio is much wider than the standard mentioned, ranging from 1 : 8 to 1 : 13. With the mixed diet, containing meat, which is rich in protein, the ratio was narrowed to about 1 : 7. On the other hand, by the addition of syrup to the simple hoe-cake diet, a ratio originally too wide became still wider, 1 : 15.4, and the digestibility of the protein suffered.

4. From an inspection of the carbohydrate column it is difficult to draw any conclusion farther than that the carbohydrates are almost completely utilized in the body, whether they are derived from white bread or from any of the corn foods studied. The results shown in the last column are even less conclusive and seem to follow no discoverable law.

The figures already quoted relate to the total food eaten. By many experiments the digestibility of such simple articles of food as milk, butter and sugar has already been determined.

By accepting these factors and applying them to the accessory foods of a simple diet, it is possible to calculate the digestibility of the cereal itself. The figures given in the next table were thus obtained.

Digestibility of nutrients and energy of corn preparations alone.

	Protein.		Carbohydrates.	Heat of combustion.
	Not corrected for metabolic products.	Corrected for metabolic products.		
	Per cent.	Per cent.	Per cent.	Per cent.
Hominy	74.5	84.3	98.2	94.4
Hasty pudding	73.2	83.9	98.3	93.1
Johnny-cake	86.3	93.2	98.9	93.5
Brown bread	83.0	92.8	98.6	93.4
Hoe-cake	77.1	88.9	98.6	93.8
Hoe-cake with syrup	78.8	90.0	98.7	94.0
White flour bread	85.6	89.8	98.9	94.0

A comparison of this table with that given on page 142 indicates that these corn foods are either considerably less digestible than the other foods with which they were eaten, or they themselves become more digestible when eaten with other foods. Similar results obtained with other experiments in which certain foods were eaten both singly and with a mixed diet indicate that the second conclusion is the correct one.

A Balanced Diet.

Attention has been called to the fact that in most of the experiments here reported the diet adopted was one-sided, i. e., the proportion of protein to the fats and carbohydrates was too small. This is so common an error in diet that it may be proper to mention a few of the ways in which it may be corrected. It is evident that Indian corn in itself is too poor in protein to form a large part of the diet unless special pains are taken to maintain the proper balance. This may be done in several ways. By the addition of meats, fish, eggs, or vegetable

foods rich in protein, such as beans or peas, the balance may be restored. The same result may be accomplished by the free use of milk instead of water in the preparation of corn foods. The value of milk in thus furnishing protein is not so fully appreciated as it should be. A quart of whole milk carries more protein than one-third of a pound of beef round. Skim milk is both better and cheaper for this purpose, since it carries a slightly higher percentage of protein than whole milk, and contains very little fat. Two quarts of skim milk, costing but 5 cents, furnish nearly as much protein as a pound of beef round, and more real nutriment than a quart of oysters costing 35 or 40 cents. Yet the skim milk is too frequently wasted or fed to calves and pigs. The intelligent housewife may easily find a hundred ways in which this valuable by product could be more directly and profitably utilized as a food for man.

The use of large amounts of butter, pork, or other fatty foods in connection with corn foods is to be deprecated, since the difficulties in the way of establishing a proper balance between the protein and other nutrients is thus increased. The effect of syrup in depressing the digestibility of protein has already been alluded to. Sugar and molasses are open to the same objection and for the same reason. The craving for these food accessories is an example of the fact that the appetite is not always a safe guide.

The coarsely milled forms in which corn is placed upon the market naturally call for more prolonged cooking, not only to break down the starch grains, but to rupture the walls of the cells and thus expose their contents to the action of the digestive juices. It is probable that much of the difficulty occasionally experienced in digesting corn breads might be avoided by a careful attention to these facts. At present there is but little difference to the consumer in the retail cost of corn meal and wheat flour. Both are among the cheapest of our foods. The question of economy need not be considered in choosing between the corn and wheat breads. In general it may be said that the corn products are more digestible than is commonly supposed. Not only their digestibility, but their cheapness and the readiness with which they may be converted into palatable foods suggest a more extended use and entitles them to a much higher place in the popular estimation.

DIGESTION EXPERIMENTS WITH CHESTNUTS.

L. H. Merrill.

A few years ago this Station made quite a study of the nutritive value of nuts, the results of which were published in Bulletin No. 54.* At that time it was planned, as part of the nutrition investigations in cooperation with the U. S. Department of Agriculture, to make digestion experiments with mixed diets in which nuts should form an important part of the food consumed. Only two such experiments with chestnuts were made. The results have been held unpublished hoping that opportunity would come to add to the number of experiments with chestnuts, and also with other nuts.

As shown in the following table, chestnuts differ materially from most other nuts in carrying large amounts of carbohydrates, but little fat, and for the most part relatively small amounts of protein. In fact, they more nearly resemble Indian corn in composition than ordinary nuts.

The dry matter of the meats (kernels) of chestnuts compared with the meats of other nuts † and with corn meal.

	Protein.	Fat.	Carbohydrates.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.
Almonds	22.1	57.6	18.2	2.1
Filberts	16.2	67.8	13.5	2.5
Pecans	10.6	72.9	14.7	1.8
Walnuts	17.2	66.3	15.2	1.3
Chestnuts	11.3	11.0	75.2	2.5
Corn	11.2	4.8	82.4	1.7

*Nuts as Food, Bul. 54, Maine Agricultural Experiment Station, 1899.

† Analyses taken from Bulletin 54 of this Station.

THE EXPERIMENTS HERE REPORTED.

In the experiments a mixed diet was used in which chestnut flour made a prominent part. Each subject consumed daily 300 grams of the chestnut flour, which furnished about one-fifth of the proteids, one-half of the fat, nearly one-half of the carbohydrates and three-eighths of the total fuel value of the food.

In the table which follows, there is given the chemical composition of the food materials used. The chestnut flour was prepared by shelling the nuts, which were then partly dried and blanched by 20 to 30 seconds immersion in boiling water, again dried, and ground. The bread was made from a straight flour from Northwestern grown wheat. The whole milk was drunk at the meals and the skim milk was used in making the bread. The chestnut flour was eaten as mush.

The details of the experiment are given in the tables on page 148.

Percentage composition of the chestnuts from which the flour was made and of food materials used in the digestion experiments here reported, and heats of combustion per gram, calculated to water content at time when used.

Laboratory Number.	Experiment Number.	Material.	Water.	Nitrogen.	Protein.	Fat.	Carbohydrates.	Ash.	Heats of combustion. Determined.
			%	%	%	%	%	%	Cal.*
6393..	......	Whole nuts....................	40.00	......	3.40	1.90	42.50	1.20	2.120
6393..	......	Kernels (meats flesh).......	44.89	......	3.85	2.10	47.75	1.41	2.372
6416..	39-40	Chestnut flour...............	6.36	1.02	6.38	3.32	81.54	2.40	3.958
6417..	39	Bread.........................	35.39	1.73	10.81	.52	51.28	2.00	2.799
6418..	40	Bread.........................	38.65	1.64	10.23	.49	48.55	2.08	2.639
6374..	39-40	Potato	75.46	.37	2.32	.20	21.02	1.00	1.002
6420..	39-40	Milk	87.63	.57	3.56	3.29	4.84	.68	.732
6419..	39-40	Skim milk....................	90.37	.62	3.88	.48	4.61	.66	.436
6421..	39	Feces	6.17	6.35	39.69	12.15	27.23	14.78	5.132
6422..	40	Feces	6.19	6.16	38.50	11.28	25.85	18.18	4.775

*Calories per gram.

DIGESTION EXPERIMENT No. 39.

Kinds of food: Chestnut flour, bread, potatoes and milk.
Subject: E. R. M. Age 23 years.
Weight (without clothes); at beginning 136.7 lbs., at close 134.1 lbs.
Duration: 3 days, 9 meals.

Laboratory Number.		Weight of material—Grams.	Total organic matter—Grams.	Protein N x 6.25—Grams.	Fat—Grams.	Carbo-hydrates—Grams	Ash—Grams.	Heat of combustion—Calories.
6416	Chestnut flour..........	900.0	821.2	57.4	29.9	733.9	21.6	3562
6417	Bread....................	1275.0	798.3	137.9	6.6	653.8	25.5	3569
6374	Potatoes	40.0	9.4	.9	.1	8.4	.4	40
6420	Milk......................	150.0	17.5	5.3	4.9	7.3	1.0	110
6419	Skim milk	2700.0	242.1	104.6	13.0	124.5	17.8	1177
	Sugar....................	100.0	100.0	....	....	100.0	....	396
	Total	....	1988.5	306.1	54.5	1627.9	66.3	8854
	Feces....................	....	93.0	46.7	14.3	32.0	17.4	604
	Estimated feces from food other than chestnuts....................	....	24.2	13.2	.4	10.6	....	120
	Estimated feces from chestnuts	....	68.8	33.5	13.9	21.4	....	484
	Total amount digested	....	1895.1	259.4	40.2	1595.9	48.9	8250
	Estimated digestible nutrients in chestnuts	....	752.4	23.9	16.0	712.5	....	3078
		%	%	%	%	%	%	%
	Co-efficients of digestibility of total food...	....	95.3	84.7	73.8	98.0	73.8	(93.2)
	Estimated co-efficients of digestibility of chestnuts alone	....	91.6	41.6	53.5	97.1	....	(86.4)

DIGESTION EXPERIMENT No. 40.

Kind of food: Chestnut flour, bread, potatoes, and milk.
Subject: H. A. M. Age, 34 years.
Weight (without clothes); at beginning 130.7 lbs.; at close 129.3 lbs.
Duration: 3 days, 9 meals.

Laboratory Number.		Weight of material—Grams.	Total organic matter—Grams.	Protein N x 6.25—Grams.	Fat—Grams.	Carbo-hydrates—Grams	Ash—Grams.	Heat of combustion—Calories.
6416	Chestnut flour..........	900.0	821.2	57.4	29.9	733.9	21.6	3562
6418	Bread	1275.0	755.7	130.5	6.2	619.0	26.5	3365
6374	Potatoes	40.0	9.4	.9	.1	8.4	.4	40
6420	Milk	150.0	17.5	5.3	4.9	7.3	1.0	110
6419	Skim milk..............	2700.0	242.1	104.6	13.0	124.5	17.8	1177
	Sugar........	100.0	100.0	....	....	100.0	....	396
	Total	....	1945.9	298.7	54.1	1593.1	67.3	8850
	Feces....................	....	59.1	30.1	8.8	20.2	14.2	373
	Estimated feces from food other than chestnuts	....	23.2	12.6	.4	10.2	....	114
	Estimated feces from chestnuts	....	35.9	17.5	8.4	10.0	....	259
	Total amount digested	... .	1886.8	268.6	45.3	1572.9	53.1	8477
	Estimated digestible nutrients in chestnuts	....	785.3	39.9	21.5	723.9	....	3303
		%	%	%	%	%	%	%
	Co-efficients of digestibility of total food...	....	97.0	89.9	83.7	98.7	78.	(92.7)
	Estimated co-efficients of digestibility of chestnuts alone......	....	98.1	69.5	71.9	98.6	....	(92.2)

PLANT BREEDING IN ITS RELATION TO AMERICAN POMOLOGY.

W. M. MUNSON.

The whole question of plant and animal breeding is in a state of transition, for, with a sudden interest in Mendel's work, and the generalizations of De Vries and others, investigations in breeding are taking a new direction, not necessarily less practical in final results, but at present less comprehensible to the average man. It has therefore seemed worth while to give a brief statement of methods heretofore employed in plant breeding, in their relation to the development of American fruits, and a summary of the results already accomplished.

The breeding of plants, as of animals, is quite as much a question of culture, care and selection, as it is the production of a departure from a given type. Most plants live an indifferent existence, dependent very closely upon immediate conditions of environment. Furthermore, every part of a plant lives largely for itself and is capable of propagating and multiplying itself if removed from the parent plant. This fact increases the importance of suitable environment, and of a knowledge of methods of propagation on the part of one who is to undertake systematic breeding. In the study of plant breeding then, for all practical purposes, the unit is the embryo individual plant, whether in the form of a seed or a bud. While in the light of recent investigations this statement may be regarded as somewhat antiquated, the writer would still maintain the position that in the prosecution of the practical improvement of the American fruits, this proposition will hold. Of course in the scientific investigation of the principles of plant breeding, embryological conditions are of importance.

In recent times the student of plant breeding thinks that he has a key to the laws of plant variation in the so-called "Mendel's Law," and there are many facts which tend to strengthen

that belief, but a discussion of that subject is not intended at this time.

Beginning of Systematic Breeding of Fruits.

One of the most significant facts in nature is that every species of plant which man has cultivated for any length of time has numerous forms, varieties, or strains. The practical horticulturist selects that form or strain which is best for certain purposes or for certain conditions. The plant breeder asks why or how these forms came about and how they can be improved. It is worthy of note, however, that until about a century ago the principal studies of plant life were made from wild forms rather than from domesticated species.

THE WORK OF VAN MONS.

The man who first propounded a theory of the philosophy of the origin of varieties of cultivated plants, was Jean Baptiste Van Mons, who was born in Brussels, in 1765, and died in 1842. Van Mons was by profession a chemist, and horticulture was his avocation. His theory applied particularly to fruit trees, but he held that the principles he set forth are of general application in the vegetable kingdom.

Van Mons' theory may be briefly epitomized as follows: All fine fruits are artificial products. There is always a tendency in all varieties of fruit trees to return, by their seeds, towards a wild state. This tendency is most strongly shown in the seeds borne by old fruit trees. On the other hand, the seeds of a young fruit tree of a good sort, being itself in a state of amelioration, have the least tendency to retrograde, and are most likely to produce improved sorts. Finally, there is a limit to perfection in fruits. When this point is reached, as in the finest varieties, the next generation will more probably produce poorer fruits than if reared from seeds of an indifferent variety in the course of amelioration.

This system or theory was not founded upon experience or practice, but was a preconceived idea of the author, who spent fifty years, with all the zeal of an enthusiast, in an attempt to prove his theory. He began his work by gathering seeds from a young seedling tree without paying much attention to its quality except that it must be in a state of variation. The seed-

lings were planted closely in nursery rows and often checked by pruning, with the thought that to improve the fruit the original rank growth of the tree must be subdued or enfeebled. From the first fruits produced, and the fruit was always gathered before it was fully ripened, seeds were saved and sown again; and this practice was continued generation after generation. The whole process was, to use his own words: "To sow, to re-sow, to sow again, to sow perpetually; in short to do nothing but sow is the practice to be pursued and which cannot be departed from." Van Mons' work, which was largely confined to pears, was begun in 1785. Thirty years later, in 1823, when he had commenced distributing scions freely throughout the world, he had 80,000 seedling trees in his nursery. At this time his first catalogue was issued and in it 1050 pears are mentioned by name or number. Of this list 405 were his own creation and 200 of them had been considered worthy of naming, among them being some of the varieties which are still raised the world over, including Diel, Bosc, Colmar, Manning's Elizabeth, and many others of equal merit. Many of these varieties found their way into America, chiefly through the efforts of Robert Manning of Massachusetts.

Whatever may be thought as to his theories, there is no doubt that Van Mons accomplished more than any other single individual up to the middle of the nineteenth century in breeding new and valuable fruits. Without discussing the principles for the establishment of which Van Mons was working, it is enough to say that in some of his series the generations came into bearing earlier and earlier until in the fifth generations of certain pears, he was able to secure fruit at 3 years from seed. As already intimated, however, this was at least partly brought about by the system of enfeebling and consequent encouragement of the habits of precocity, and by cumulative selection. Probably no worker with plants has ever given to the world so clear a demonstration of the value of selection as Van Mons; and this demonstration is worth all of the efforts put forth, even though this was made in the attempt to prove another and, as is now believed, erroneous doctrine.

WORK OF THOMAS ANDREW KNIGHT.

Contemporaneous with Van Mons, was Thomas Andrew Knight, often referred to as the father of modern horticulture; a man whose work as a careful, accurate, scientific investigator of the phenomena of plant life, especially in its economic relations, is unrivaled even at the present time, and whose opinions upon the studies of crossing and of plant development were of the utmost importance. Knight was born in England in 1759 and died in 1838. His investigations of problems in physiological botany have become classic and he brought the same energy and thoroughness to his investigations of horticultural problems. He gave particular attention to the physiology and methods of crossing plants and was the first to perfect the method of root grafting,* but his greatest work was in the direction of the improvement of cultivated plants, by breeding. He took up the question of the running out of varieties and made great efforts to produce new ones. He was confronted by the same problems which appealed to Van Mons, but he approached the subject in a very different way. Knight asked direct questions of nature, and never arrived at a general theory of the improvement of plants, although he was not without hypotheses concerning the phenomena he was studying.

Van Mons, as noted, was the first to demonstrate the importance of selection in the improvement of plants; Knight was the first to show the value of crossing for the same purpose. As early as 1806 he wrote: "New varieties of species of fruit will generally be better obtained by introducing the farina of one variety of fruit into the blossoms of another, than by propagating any from a single kind." † The varieties which he raised, largely by means of crossing, included apples, pears, plums, peaches, cherries and strawberries, as well as many vegetables such as potatoes, peas, cabbages and others; but more important than the new fruits, which were of immediate and so-called practical value, was the contribution to the general knowledge of plant life, and of the methods to be employed in amelioration, which Knight gave freely for the benefit of all mankind.

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* See Transactions of London Horticultural Society.

† Ibid. Vol. 1, p. 38, 1806.

Such, in brief, are the beginnings of the science of plant breeding, as exemplified in the amelioration of domesticated fruits. Early in the nineteenth century the more advanced horticulturists were awakening to the fact that plants as well as animals are capable of improvement by systematic breeding. As the years have gone on, knowledge of the factors involved, and of methods of procedure, has increased, with the result that a new horticulture has developed in this country. European varieties and European methods of culture have been superseded by varieties and methods of American origin,—varieties and methods better suited to the very different climatic conditions and to popular demands.

THE DEVELOPMENT OF AMERICAN POMOLOGY.

The records of early attempts at fruit growing in America are mostly records of failure. The varieties first grown were naturally those brought from Europe, and though in the beginning of the last century American seedlings were beginning to attract attention, still the chief effort to extend the range of culture was by the introduction of new varieties from Europe. This was the only way known of securing new sorts.* In 1830, in a letter to Gen. Dearborn, William Kenrick says: "From among 150 varieties imported into Boston by Eben Preble about 1805, the only additions to desirable kinds were two cherries, the Black Tartarian and the White Tartarian, and a single pear." † If fruit culture in this country were limited to the varieties which have come from Europe, it would be of very small proportions. At the present time, while agents of the Government are scouring the world for new species and varieties, plant introduction is very largely looked upon merely as a means to an end. Russian, Chinese and Japanese fruits are being freely introduced, not merely for their intrinsic merit, and in the hope that they may thrive in their new environment, but with the idea that from hybrids between them and the native species, and from American grown seedlings of these imported species, valuable sorts may be obtained.

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* An interesting study in this connection is that of the development of the native grape.—See Bailey, Evolution of our Native Fruits.

† Manning, History of Massachusetts Horticultural Society, p. 42.

CHANCE SEEDLINGS.

In the development of American pomology the first step was a sort of crude selection of chance seedlings, wherever these might be found. The importance of having varieties adapted to existing conditions was early understood, but the question of how to get them was the trying one. It is a notable fact that many of the varieties which today stand out as landmarks, were accidental seedlings or chance discoveries of valuable wild forms.

Among the more prominent American fruit originating in this way may be mentioned the Alexander or Cape grape, which first introduced successful grape culture into Eastern America; the Catawba, still a popular grape; the Dorchester and Lawton blackberries; Seckel pear; Wealthy apple; and many of the best raspberries, gooseberries, cranberries and plums.

SELECTION.

The next step in the improvement of fruits was the selection of parents from which to grow seedlings. The importance of the work Van Mons was doing in Belgium, in emphasizing the principle of selection, has been noted above, but American horticulturists soon outstripped their teacher. In 1882 James Thatcher, in his American Orchardist, made recommendations which today would be regarded as much better than those of Van Mons. He says: "The seeds for planting should always be selected from the most highly cultivated fruit and the fairest and ripest specimens of such variety." William Kenrick, a nurseryman of Roxbury, Mass., was more conservative and inclined to adopt the theory of the natural deterioration of varieties,* at the same time giving in detail the methods practiced by the great European plant breeder, as already described.

A few examples of fruit originating from seed of carefully selected parents will suffice. Diana, early recognized as a valuable child of Catawba; Moore's Early, Worden, Pocklington and the other numerous progeny of Concord, among grapes; Shiawassee, Princess Louise and McIntosh, as seedlings of the Fameuse apple, as well as the numerous offspring of Oldenburg, Rhode Island Greening and others; the seedlings

* Kenrick's New American Orchardist, pp. 24-32.

of Green Gage plum; the Tartarian cherries; and the Crawford peaches are familiar cases in point. But of the immense number of seedlings produced in this rather haphazard way, very few have been found of superior merit. Improvement by selection, in the strictest sense, has been employed most successfully with annual plants, and the methods used have been gradually perfected. In the choice of the foundation stock, however, the same principles are involved in breeding fruits as in the production of choice wheat, corn or cotton, namely: Select parents from stock grown in a locality likely to produce vigorous, hardy plants, and choose individuals of special merit in some particular direction. In the improvement of grapes, many failures have resulted from the choice of tender varieties as parents, although the quality of fruit was greatly improved. In the work of adapting fruits to different climatic conditions of the states west of Lake Michigan, little real progress was made until the introduction of Russian and other so-called ironclad varieties as parent stock. The seedlings from varieties grown in Western Europe or Eastern America were entirely unsuited to the new conditions.

Having the stock from a suitable locality, it is of the highest importance that the individual parent from which seedlings are to be raised shall be the very best of its kind. In working for size in fruit, it is not enough that a plant shall produce one or two abnormally large specimens, but that plants producing a large number of uniformly large specimens should be chosen. In other words, the parent plant should possess in the highest degree the qualities of the ideal form sought, a principle directly contrary to that originally taught by the apostle of selection.

CROSSING.

Cross-fertilization and hybridization were little used in the improvement of plants during the first half of the last century. Knight had shown what might be done, and he had many followers in this country, but the opinion of Van Mons, strengthened by the indisputable array of choice fruits he had obtained as a result of selection, was almost equally strong. In 1836 A. J. Downing wrote: "Assuming Professor Van Mons to be strictly correct, we would suggest that a great saving of time,

and a considerable improvement in quality and vigor, might be gained by calling in cross-fertilization to the aid of the cultivator as soon as the fruit of the trees (say the second generation) begins to show symptoms of amelioration. By impregnating them with pollen of the finest varieties we conceive that the next generation would produce excellent fruit and at a saving of twenty or thirty years." *

In 1844 C. M. Hovey, one of the most successful of the earlier plant breeders, definitely championed the cause of cross-fertilization on the ground that "the results will be obtained in a shorter period and, we believe, equally as favorable as by the method of successive generations alone." Mr. Hovey spoke from experience, his first cross-bred strawberry seedling having been brought to notice in 1838. The striking successes of Hovey, Allen, Downing, and others, soon led to the general adoption of cross-fertilization as a method in the improvement of fruits, and for the last half century the advance has been in the minor factors and not in a better understanding of principles. Up to the present time the question of dominant and recessive characters, as developed in the offspring of crosses, has had very little bearing upon the status of American pomology.

The early hybridizers often used a mixture of pollen, believing that it was possible for the same seed to be influenced by pollen from two different sources, and the possibility of superfœtation was often discussed. The Duchess grape is a result of one of these mixed crosses. This was produced by Caywood "by crossing a White Concord seedling with Delaware or Walter, the pollen of both being applied at the same time." *

One breeder of grapes claimed to produce his new varieties by a new and very simple process, namely by diluting the pollen of the male flower with rain water and then applying it to the pistils of the variety selected as the female parent.†

As a knowledge of the process of fecundation became more clear, other methods of securing desired combinations were adopted and compound hybrids or derivative hybrids became common. Some of the best results have been obtained by such combinations; for example the Brighton grape, which is a

* Bushberg Catalogue, 3rd edition, p. 94.

† Ibid, p. 118.

cross between Diana-Hamburg and a seedling of Concord. The method of using what Webber has called "dilute hybrids" has also been employed with success, particularly in the fixation of types.

THE LIMITS OF CROSSING.

"Crossing is useful as a means of originating new forms adapted to man's special uses and also as a means of revitalizing the offspring by providing new combinations of characters which may better enable the individual to compete in the struggle for existence; but there are limits beyond which crossing is useful neither to the species nor to man." ‡

Without discussing this subject at length, it may be said that, within certain limits, the wider the divergence of the parents in any fertile cross, the more vigorous the progeny. This statement rests on the broad basis of fact, and is corroborated by the work of Darwin and others down to the present day. Nature has comparatively few varieties, the initial variation being usually crowded out in the fierce struggle for existence; but among cultivated plants instead of struggle for existence and the survival of the strongest, we have a struggle for improvement and a "survival of the most coveted." Weeds are best fitted to survive, but the hoe and the cultivator enable the weaker and, for man, the more desirable species to prevail.

So then cultivated plants, leading a life of comparative peace, expend their energies along the lines which are laid down by man. Variations appear and are carefully watched, guarded, and propagated; with the result that in time a new type or variety is produced. But the conditions are vastly more variable than are those under which their wild allies are growing. This leads to a wide range of characteristics found in the same variety, consequently unions are here more powerful than in the wild state, and the expert plant breeder is he who manipulates these forces and their combinations to the best advantage. In the past history of plant breeding this manipulation has necessarily been carried on more or less blindly, but the work of Mendel, DeVries and others seems to open wonderful possibilities in this direction.

‡ Bailey, Philosophy of Crossing Plants.

THE INFLUENCE OF SOIL.

One of the most commonly recognized factors in environment is that of soil conditions. It has been observed by tomato growers, and is commonly taught, that more fruit is obtained on relatively poor soil than on rich.* It should be borne in mind, however, that this increased fruitfulness—at least in the case of the tomato—is relative rather than absolute; that while the proportion of vine is greater on rich soil, the actual amount of fruit is also much greater, and the individual fruits are larger and fairer.†

With this supposition in view, some have thought to produce fruitful varieties by a process of selection and the transmission of the characters of fruitfulness thus acquired. Certain of the small fruits are known to flourish on particular soils or under definite conditions and nowhere else. Particularly is this true of the strawberry, the raspberry and some grapes.

THE USE OF UNRIPE SEED.

As a means of checking too vigorous growth and increasing fruitfulness, the method of using immature seed has been employed with a certain measure of success. It has been found that the use of immature seed increases the productive parts at the expense of the vegetative and thus it comes about that more fruit is formed in proportion to the foliage than is normal. In a series of experiments conducted through several generations by Goff and Arthur, ‡ it was found that a tomato plant selected as a representative of the series grown from unripe seed bore 3½ pounds of fruit to one pound of vine (leaves, stems and roots taken together); while a plant of the same variety grown each year under the same conditions but always from ripe seed gave only 1⅛ pounds of fruit for every pound of vine. We have here then an enormous relative increase of fruitage from unripe seed which in fact "was quite apparent to the casual observer upon looking at the plants of the two series as they grew in the garden, although it required the scales to disclose how surpris-

* Allen, American Garden, Vol. 11, p. 358, 1890.

† Cornell Experiment Station, Bul. 10, 1889; also Ibid., Bul. 21, 1890.

‡ American Naturalist, Vol. 29, p. 905, 1895; also Rpt. Wis. Expt. Station, 8, pp. 152-9, 1891.

ingly great the difference was." * It may be well to note also that, associated with the increase in the amount of fruit, there was also an increase in the number of individual fruits, although these, as also the seed, were individually smaller. Van Mons also employed this method of using unripe seeds in his experiments with apples and pears, for the purpose of checking too vigorous growth and increasing the relative fruitfulness of the product.

Besides increasing the number of fruits, the use of unripe seed also results in early maturity. In the cumulative trials of tomatoes, already mentioned, the strain from immature seed ripened from 10 days to 4 weeks earlier, in different years, than did the corresponding series from ripe seed. Such differences in earliness do not always occur, however, and some observers have noted opposite results; but with the earlier production and the increased percentage of fruit comes also the lowering of vitality and consequent lessened ability to stand unfavorable conditions. In other words, the use of unripe seed is simply a means of checking growth and the usual result follows. Within certain limits checking growth tends to increase fruitfulness, no matter how the check is given. Some have contended that the plants would overcome the initial weakening and upon being subjected to favorable conditions would acquire vigorous growth while retaining the more fruitful habit. Of course this is the end desired as a result of this method of treatment, but, so far as the writer is aware, there is nothing to warrant such a supposition. Experience in breeding tomatoes at this Experiment Station indicates that this desired end is not obtained.

BREEDING FROM ASEXUAL PARTS.

The distinction between seedling varieties and bud varieties is one of degree rather than of kind. The different buds on a tree frequently produce offspring possessing quite as distinct individuality as do the different seedlings from the same tree. So the tree should be considered not as an individual but rather as a collection of individuals, the bud being the unit. Now no two buds on a given tree are subjected to precisely the same conditions. All of the buds cannot possibly survive, hence arises

* Arthur, American Naturalist, 29, p. 906.

a constant and intense struggle for existence. Owing to the different conditions of light, air, food, and room for extension, some branches will be large and vigorous, others will be small and weak; some will produce fruit freely, others will be barren. In the same way, no two fruits are ever exactly alike. Some will be large, others small; some roundish, some oblong; some highly colored and of good flavor; others pale and insipid.

This fact of the universality of bud varieties, together with the fact that variations may be perpetuated by asexual means is of the utmost importance in practical horticulture and in the systematic improvement of fruits and vegetables. The practical fruit grower knows that some trees never bear any fruit and that others of the same kind bear abundantly; that some Baldwins and Spys are habitually large, and others habitually small and unsatisfactory, and these observations are borne out by the records of the Station orchard. Upon close examination of the branches of an individual tree, through a series of years, the same phenomena would be found to exist in individual branches. A very good illustration of the case in point is that of a currant plantation cited by Powell.* A plantation of Fay currants containing some 12,000 bushes came directly or indirectly, through cuttings, from 25 selected plants, purchased when the variety was first introduced. The original plants were uniform in size and very productive. In the haste for a large number of plants the new wood was cut from these bushes every fall, and when more bushes were established they in turn were divided into cuttings as often as new wood was made. Little attention was paid to the bearing capacity of the bushes in later generations because of the excellent character of the original stock. As a result of this lack of attention, at the end of 12 years some of the bushes were found to be heavy bearers, others very light bearers and others almost barren. How this came about is readily seen, and the remedy is equally obvious. If a single bud produces a branch which is barren, or nearly so, and that branch happens to be taken as a cutting, naturally a barren bush results. If this bush, before its character is determined, is used for cuttings, the tendency is perpetuated and an ever increasing series of worthless plants is esablished.

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* American Garden, 1898, p. 466.

Some of the numerous examples of bud variations in apples, pears and other fruits will suggest themselves. In Virginia, Albemarle Pippin is a familiar example of bud variation from the Yellow Newtown. In Canada the Red Gravenstein appears. In the Northwestern states, King is hardly recognized because of its elongated form. The propagator has only to form a clear idea of the type of Baldwin, Newtown, King, or other fruit which he wishes to attain, then to select from each generation buds from branches which appear most nearly approximating his ideal. If then the differences in the buds of a tree or other fruit plant can be perpetuated by asexual means, as by cuttings, grafting, etc., it is evident that this method can be depended upon for the systematic improvement of existing varieties; and with most of the commonly cultivated fruits such improvement is vastly more important than a wholesale production of new forms.

The improvement of horticultural varieties does not necessarily follow the lines of improvement in the wild state. Nature builds up her types gradually by the selection, in each generation, of individuals best suited to their environment; in other words by a "survival of the fittest," or, as Bailey puts it, a "survival of the unlike." Man, on the other hand, selects the most coveted, and in order to attain his end supplies the environment best suited to the individual, and with the natural result.

While recognizing and emphasizing the importance of the production of seedlings from judicious crossing, it is believed by the writer that the attention to conditions of environment is infinitely more important than the multiplication of forms, in which the element of chance plays so large a part, and that, unfortunately, in many cases, the principles of selection and asexual propagation have in the past been lost sight of.

The slight differences which any careful observer will detect in the common fruits form sufficient basis for the most favorable of systematic breeding. A few examples of fruit originating in this way will suffice. The origin of the Nectarine as a bud variation of the peach is familiar. Even at the present day such variations are not uncommon. Thomas Andrew Knight records the case of a Yellow Magnum Bonum plum producing a branch which bore Red Magnum Bonum.* Powell cites a

* Cf. Darwin, Animals and Plants Under Domestication.

recent case of bud variation in which a tree of Coe's Golden Drop has produced a branch which for several years has borne red fruit. In every way except color both trees and fruit are identical with Golden Drop. In California, in an Isabella vineyard belonging to J. F. Pierce of Santa Clara, several vines sported in 1882. The fruit of these sports was very much sweeter and altogether superior to the parent variety. It shows no tendency to reversion and is now extensively grown in California under the name of Pierce, bringing a higher price than any other of the American types. It is interesting to note, too, that the Pierce is capable of reproducing itself from seed, thus becoming the first of a race of native grapes.* The grape is prone to bud variations and it is not uncommon to see a branch bearing fruit which differs in size, color or flavor from that of the remainder of the plant. The Golden Queen raspberry originated as a sport from Cuthbert, formerly called Queen of the Market, on the grounds of Ezra Stokes of Berlin, N. J., and was introduced to public notice by J. T. Lovett.

The list of bud varieties is a large one, and no doubt thousands of variations which might have been the basis of new and valuable strains have escaped the attention of horticulturists. But it is not alone to the marked variations or sports that the plant breeder will look for foundation stock. In fact the sudden or violent variations are always liable to reversion. Nature's method of evolution, is a very good pattern to follow in developing certain strains to meet human ideals. In the experimental evolution which the horticulturist is practicing, a definite course of action may be predicted. *First,* determine upon the ideal of the improved type desired. *Second,* cultivate and feed to encourage variation. *Third,* select through successive generations buds, that is cuttings or scions, from branches which bear fruit most nearly approaching the ideal.

Organic evolution has taken place by the selection in each generation of those differences which give the survivors a slight advantage in the struggle for existence. Horticultural evolution, or the systematic production of better types of cultivated plants by man, may take place by the selection of individuals (buds) in each generation which most nearly conform to the

* American Garden, 19, 514, 1898.

ideal type; since, as already intimated, the necessity for a struggle for existence has been obviated.

The whole practice of propagating the common fruits, as followed by most of the nurserymen of today, is radically wrong, and tends to deterioration rather than to improvement. Buds are often selected promiscuously from bearing trees, from barren trees, and from nursery stock of unknown character, and as a result a large proportion of the orchards all over the country contain trees which do not pay the interest on the land they occupy. In the horticultural world a stimulus is needed like that which the Babcock test gave to the dairy world. Some resultant weeding would follow and fruit growers would rise in their might and demand greater care in the production of trees.

It is encouraging to note that a few nurserymen are awakening to the situation and are advertising pedigree stock; but while the signs are hopeful, the intelligent orchardist of the future will be an amateur plant breeder; will set his trees of some strong, vigorous stock, and will top work with the variety or strain which is most desirable.

Some Results of Breeding.

In the foregoing notes some of the methods of plant breeding as applied to fruit, and something of the history of the development of the science in this country, have been given. The significance of the work, and some of the results accomplished in the evolution of American fruits, may properly be considered at this time.

At the beginning of the nineteenth century, almost all of the cultivated fruits were of foreign origin. At present fully 90 per cent of the cultivated apples, and nearly as large a proportion of the pears, are of American origin; that is, have originated from American seedlings. Of plums, the American seedlings of European and Japanese species, together with important native types, and hybrids of these with the foreign species, are rapidly assuming prominence. In the cultivation of grapes, raspberries, blackberries and gooseberries, little progress was made until native species were taken up and improved; and the last half century, indeed the last decade, has seen a most marked development in all of these fruits. It is interesting to note, as bearing upon the general advance in the amelioration of fruits,

that many of the now most important fruits were not only unheard of but were not thought of, as cultivated plants, within the memory of those now living. The improvement of native types has in nearly every case been the result of necessity rather than choice.

The introduction of fruits from Russia and from China and Japan, together with the accidental and systematic crosses between these and the native species and older domesticated types, has not only widely extended the range of fruit growing in this country, but has given a new impetus to the study of fruits and to the production of important forms to meet special requirements. The development of a few of these more important types may be profitably considered.

THE STRAWBERRY.

The strawberry has been under cultivation for centuries, but systematic attempts at improvement are of comparatively recent date, extending back a little more than 200 years in Europe and only about half a century in America. The earliest horticultural variety of which there is any account is the Fressant which dates from 1660. Wild species of strawberry are few in number, certainly not more than a dozen, and only a part of these wild forms have ever been brought into cultivation. Nevertheless, so wide has been the variation under cultivation that at the present time there is the anomaly of a fruit, appearing within a little more than a century, which the botanist does not refer to any species. Here then is a remarkable and practical example of experimental evolution. The history of this evolution has been fully worked out by Bailey, and a few brief notes of his investigations are given in this connection.*

The systematic improvement of the strawberry began in England. The first foreign species to reach Europe was *Fragaria virginiana,* the common field species of New England and the whole Atlantic coast. This is recorded in 1624, but does not appear to have varied greatly, and never found favor on the continent. In England, however, it was more highly esteemed, and after a lapse of 2 centuries—in 1824—Barnet writes enthusiastically " This (the old scarlet strawberry) was doubtless an

* Survival of the Unlike; also American Naturalist, 28, 293.

original introduction from North America. It is singular that a kind of so much excellence as to be scarcely surpassed by any of its class, should have been the first known. It continued in cultivation considerably more than half the period of its existence as a garden fruit without any variety having been produced of it, either by seed or by importation from America." * At this time, however, (1824), Barnet described 26 well marked varieties of the species, at least 4 of which seemed to have come directly or indirectly from America, and probably from wild plants. Thus at the opening of the nineteenth century considerable progress had been made in the amelioration of the strawberry by simple and unsystematic selection. The varieties, however, were much alike and gave little promise of the wonderful development which so soon followed.

About 1712 a second American species, *Fragaria Chiloensis,* was taken from Chili to Marseilles by a Captain Frezier. It reached England in 1727. The plant is stout, thick leaved, rather coarse, bearing large, globular, somewhat pointed, late, dark-colored fruit. The flowers are often imperfect and fail to become fertilized. The species met with but little favor and at the time Barnet wrote, a century after its introduction, so little variation had occurred that only 3 varieties which could be referred to this species were known, and one of these was considered identical with the original plant as introduced by Frezier. The plant was also grown to a very limited extent in France, but there seemed little save size of fruit in the parents of this species, and less in its record under cultivation, to commend it to the attention of the horticulturist.

Some 50 years after the introduction of the Chilian strawberry, a third type made its appearance in Europe. No one knew just how or when it came. Because of the pineapple fragrance of its fruit, it was commonly known as the Pine strawberry, and was described and figured as such by Phillip Miller in 1760.† There were many theories as to its origin but none were more probable than that of Duchesne who, in his Natural History of Strawberries, in 1776 ‡ described

* Transactions London Hort. Soc., 6, 152, 1824.

† Gardener's Dictionary.

‡ Histoire Naturel de Frasiers, par M. Duchesne fils.

a pineapple strawberry as *Fragaria ananassa* and argued that it must be a hybrid between the Chilian and the Virginian. Pineapple strawberries were found in France about the same time as in England, and the two, only differing from each other in a slight degree, came to be regarded as variations of the same stock; a type upon which Ehrhart, in 1792, bestowed the name *Fragaria grandiflora.*

What then is the ancestral type of cultivated strawberries? According to Barnet, whose work has been previously mentioned, there were in all 7 groups of cultivated varieties in 1824; but only 4 of these were of the large fruited types. The Pine, being comparatively a new type, included 20 distinct varieties, and among them one which marks an epoch in the annals of strawberry culture in England, namely Keen's Seedling. From Keen's Seedling, first known in London in 1821, most of the modern strawberries have descended.

At the time Keen's Seedling was produced in England, there were no important varieties of American origin and for some reason Keen's Seedling did not thrive in this country. Prince, in 1828,* mentions 30 varieties of strawberries in American gardens, all but one of which were of foreign origin, and even as late as 1837 Hovey wrote, "as yet the plants of nearly all the kinds under cultivation have been introduced from English gardens and are not suited to our climate.† At the time Mr. Hovey made this statement, however, he was at work in a systematic way at the breeding of plants which should meet existing conditions. He selected parents representing distinct ideals and the best adaptation to American conditions. In one series of crosses which he made 4 varieties were used. From these crosses two varieties, Hovey and Boston Pine were obtained.‡ Owing to the loss of some labels it is not quite certain which crosses gave these varieties, but, according to Bailey, Mr. Hovey was always confident that the Hovey was the result of Mulberry crossed by Keen's Seedling, so that the Hovey was a true pine strawberry. Hovey's Seedling was to American strawberry culture what Keen's Seedling was to English, and most

* Treatise on Horticulture, 72.

† Magazine of Horticulture, 3, 246, 1837.

‡ Magazine of Horticulture, 6, 284, 1840.

of our modern varieties have come directly or indirectly from this one source.

The American strawberries then are lineal descendants of the old Pine class, known to botanists as *Fragaria annassa* and *Fragaria grandiflora,* and this type (species?) as conclusively shown by Bailey * is a direct modification of the American species *Fragaria Chiloensis.*

The history of the production of later varieties is simply a repetition of the work started by Hovey;—a history of crossing and selection with reference to certain specified ideals or in many cases of fortuitous variation and chance discovery. It has been thought that a common perfect flowering variety might impress itself upon a pistilate sort, through its pollen, to such an extent as to effect an immediate modification of the quality or character of fruit.† But further study invariably reverses any such conclusion. Much valuable work, however, has been done, and is being done, in the systematic combining of characters of different varieties by crossing and in the "selection of the most coveted." Attempts to modify the habit of strawberry plants by change of environment have not been particularly successful; though some forms, like the Parker Earle, show a strong tendency to curtail the runners, and varieties strongly resistant to fungus attack are numerous.

GRAPE.

The grape has for many years been the object of systematic work by American horticulturists. It is worthy of note, however, that many of the varieties most highly prized at the present day,—including Catawba, Isabella, Vergennes, Herbemont, Norton's Virginia and others—are simply chance seedlings, discovered in the wild, and domesticated by some careful observer. Some of the varieties named have given many seedlings of merit, besides the definitely recorded crosses made in more recent years. Catawba, for instance, has given Diana, Iona and many others; while Concord, which was a chance seedling discovered by Ephriam W. Bull and first sent forth in 1853, is the parent of a large family of valuable sorts including

* Am. Nat., 28, 301.

† Proceedings of the American Pomological Society, 1885, p. 66.

Eaton, Martha, Moore's Early, Pocklington, Worden, and others.

A marked step in the improvement of the grape was made in 1850 when John Fiske Allen of Salem, Mass., crossed the foreign Golden Chaselas with Isabella. The first of these American hybrid grapes, known as Allen's Hybrid, was exhibited before the Massachusetts Horticultural Society September 9, 1854. Though of excellent quality, this grape was so tender and subject to rot that it was never widely planted. It is of importance, however, as one of the parents, with Concord, of that delicious white grape Lady Washington; but its chief significance was the fact that it was the beginning of a new era in the improvement of grapes, namely, the production of seedlings of known parentage by means of systematic crossing.

With a few exceptions, all of the American table grapes are the result of careful selection and breeding since 1850; and a record of the productions since that date is a record of the work of Rogers, Ricketts, Caywood, Jacob Moore, Munson, Campbell and other equally enthusiastic amateurs or practical nurserymen.

There is little difficulty in producing seedling grapes of the finest quality by crossing the best native species with varieties of *Vitis vinifera*. Unfortunately, however, hardiness of vine and vigor of constitution are usually sacrificed. Occasionally a seedling is produced which combines the excellence of the two parents, and here is the first step in improvement. It was along this line that E. S. Rogers of Roxbury, Mass., following the lead of Allen, worked; and many of his hybrids have justly won a place in popular favor. Among these may be named Salem, Agawam, Wilder, Massasoit, Goethe. The greatest weakness of these varieties results from their imperfect blossoms and consequent irregular bunches of fruit. Rogers believed that the line of improvement lay in crossing his hybrid with the foreign species; but, though thus producing fruit of exquisite flavor, the increased tenderness and weakness of the vines rendered these second crosses nearly worthless.

J. H. Ricketts, a bookbinder of Newburg, N. Y., for more than 20 years continued his careful work in the production of crosses and hybrids. His early work, like that of Rogers, was mainly in the effort to produce hybrids with the European grape. Later, however, he undertook the production of derivi-

tive hybrids and crosses among our native species. Some of the results of his work are Empire State, Lady Washington, Eldorado and Jefferson.

Jacob Rommel of Morrison, Mo., holds the place as a leader in the production of wine grapes adapted to the conditions of the Southwest. Among his products may be mentioned Elvira, Amber, Black Delaware and Pearl—all products of crosses with native species, mostly *Vitis riparia* and *Vitis labrusca.*

Jacob Moore of Brighton, N. Y., was the originator of several valuable grapes as well as other fruits. It is enough to mention Brighton and Diamond. The first a cross of Concord and Diana-Hamburg; the other also a secondary cross between Concord and European (Vinifera) stock. (Diamond is a cross between Concord and Iona).

George W. Campbell of Delaware, Ohio, after spending many years working at random, settled on the definite work of improving existing types along certain well defined lines. For example a Catawba without the tough acrid pulp about the seeds; a Delaware of larger size and more vigorous habit, or a Concord of fine flavor and better shipping qualities. His greatest success was in his last mentioned effort, the result being Triumph and Campbell's Early, which are really improved Concord.

Dr. A. T. Wylie of North Carolina should be mentioned because of his attempts to bring into service the native Scuppernong grape in producing hybrids for growing in the far South.

The list of those who have contributed to the number of varieties of grapes suitable for different conditions and localities, varieties of intrinsic merit, is a long one, and it is unnecessary to speak in detail of the work of Caywood, of Barry, of Arnold, of Grant, and some others; but the man who has done the most extensive work in improving the native species of grapes, and extending the list of varieties suitable for the Southern States, is without question Mr. T. V. Munson of Dennison, Texas. The value of his work is not confined to the South alone, however, as those who are familiar with Brilliant and others of his newer varieties are aware. Among the best of the Munson productions are America, Beacon, Captain, Carman, Brilliant, Gold Coin, R. W. Munson. During the past 25

years Mr. Munson has produced 75,000 seedling varieties, including hybrids between the Post-Oak grape of the South and several other native species, as well as combinations of well known varieties and species.

THE PEAR.

The European pear is of particularly fine quality and in recent years has been found to succeed well on the Pacific Coast, but it has never proved wholly satisfactory in the Eastern States and is a total failure in the South. As will be remembered, Flemish Beauty and several of our choicest European varieties are found especially subject to disease, and in the earlier years of American pomological history the failure of the varieties which were general favorites in France and Belgium was attributed to deterioration of the variety itself,—in other words to "running out." William Kenrick wrote of these pears: * "Except in certain sections of the city, and some few solitary and highly favored situations in the country round, they have become either so uncertain in their bearing—so barren—so mortally diseased—that they are no longer to be trusted; they are no longer what they were once with us, and what many of them are still described to be by most foreign writers."

One of the first varieties of native introduction was the Seckel, and to this day it remains the standard of excellence among pears. The origin of this variety is not quite certain, though it is supposed to have been a chance seedling. It first attracted attention in the garden of Mr. Seckel of Philadelphia, who is generally regarded as the originator; but Thomas Andrew Knight believed it to have originated in a Swedish settlement near the city about the middle of the eighteenth century, Mr. Seckel having obtained cions of it from Jacob Weiss, who obtained the original tree from the Swedes.†

Some other well known varieties originated as chance seedlings in the early part of the last century. Among these may be mentioned Tyson, Andrews, Fulton and some others. As the superior value of American seedlings became recognized, the practice of planting the seeds of the best fruits became common. One of the most extensive producers of these seedling varieties

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* New American Orchardist (2nd ed.), 25.

† Cf. Trans. Lond. Hort. Soc'y, 3:256, 1819.

was Mr. Dana of Massachusetts, the originator of Dana's Hovey. This sort appeared about 1860, and was the best of his seedlings, of which he had some 5 or 6 thousand.

Among the best known varieties originating in Maine may be mentioned Eastern Belle and Indian Queen, seedlings raised by Henry McLaughlin, Bangor; McLaughlin, sent out by S. L. Goodale of Saco; Goodale, a seedling of McLaughlin; and Fulton, a chance seedling from Topsham.

The development of the cultivated pear owes little to the hand of man in producing hybrids; yet, with the possible exception of Bartlett, the few hybrid varieties produced—notably Kieffer, Le Conte, and Garber—are by far the most important commercial sorts, and have made possible the cultivation of the pear over the greater part of our country. These varieties, as now generally recognized, are accidental hybrids between the European pear and the Chinese sand pear. The latter is a vigorous, healthy tree, of no value save for ornament or as stocks for other sorts, but is native to a region not unlike our own eastern and southern states. The hybrids combine to a large degree the good qualities of both parents, and point the way to new fields of investigation for the plant breeder.

THE APPLE.

As in the case of pears, the Newtown Pippin apple, which is usually regarded as a standard of excellence, originated as a chance seedling, nearly 200 years ago. Because of its better adaptation to the climate, the apple was much more widely grown than the pear, and the production of new varieties from seed was very common. Until very recently, however, the varieties were usually the result of chance. The Baldwin, which was found in Eastern Massachusetts, in 1742, took its name from Col. Baldwin, who first brought it into general notice. The Northern Spy, originating near Rochester, N. Y., about 1800, the Roxbury Russet, the Jonathan, and, in short, most of the older commercial varieties, came about in this way.

Systematic breeding of the apple in this country is yet in its early infancy, though as long ago as the time of Knight and Van Mons crossing and selection were practiced. With the westward march of civilization the necessity of producing

hardier varieties became evident. The struggles and failures and disappointments of Peter M. Gideon in the effort to produce a variety which should withstand the trying climate of Minnesota were finally, after many years and the loss of thousands of seedlings, rewarded by the production of the Wealthy. With the introduction of this variety began a new era in the fruit culture of the northwest—indeed, this was the starting point of successful fruit growing in that region. The introductions of Russian varieties by the Department of Agriculture and by Budd and Gibb, followed by the crosses of these sorts with the hardier commercial varieties and with the native crabs, are recent history. The work of Budd, Harris, Patten, Somerville, Watrous and others in this direction has resulted in a large number of so-called ironclad varieties of very fair quality, many of which will keep until late in the spring. But this work is only begun. A discussion of the varieties originating in Maine will form the subject of an early bulletin from this Station.

THE PLUM.

The production and propagation of named varieties of native plums dates from 1814, when the seed which produced what is now known as the Miner plum was planted by William Dodd, an officer under General Jackson.* The Wild Goose was introduced in 1850, and Robinson in 1884. The latter is of special importance as one of the parents of some of Burbank's recent novelties. Since 1860 the number of valuable seedlings of the native species in the West and South is almost phenomenal. Wayland, Moreman, Golden Beauty, Newman, and others in the Southwest; Wolf, De Soto, Rollingstone, Forest Garden, Weaver and the like in the Northwest, to the number of a hundred or more, are already grown to an important commercial extent, and it is possible that these will form the foundation of the future orchard plums of the Prairie States.

Only recently has any attempt at improvement by artificial crossing been made; and this attempt has been mainly at combining the native species with the newly introduced Japanese sorts. The work began less than 20 years ago, yet, on the authority of Professor Waugh, there are at the present time

* Cf. Bailey, Evolution of our Native Fruits, 175.

more than 30 of these hybrids which have been found valuable and named. Luther Burbank of Santa Rosa, California, is the name which is indelibly associated with the idea of Japanese plum hybrids, and to him we are indebted for Climax, Chalco, Wickson, Golden, American, and many others.

THE BLACKBERRY.

Brief reference should be made to the blackberry as a purely American plant. Though wild plants had been brought to the garden previously, the culture of the blackberry as a garden fruit dates from the introduction of the Dorchester, a chance seedling found in Dorchester, Mass., and brought to attention by Mr. Lovett in 1850. A few crosses have been introduced, but none as yet have become well known. A noteworthy hybrid of the blackberry with the raspberry should, however, receive passing notice. This is the Princess (Western dewberry crossed by Siberian raspberry) produced by Mr. Burbank. The hybrid, according to the originator, ripens its fruit several weeks before either of its parents and excels them much in productiveness and size of fruit, though retaining the general appearance and combined flavors of both. Among other raspberry-blackberry hybrids made by Burbank is Humboldt, by crossing an improved California wild dewberry with Cuthbert raspberry. As giving an idea of the uncertainty of work of this kind, it is worthy of note that the last named hybrid was the only one out of 40,000 seedlings that was deemed of sufficient value for propagation.

SOME UNSOLVED PROBLEMS.

Each year marks a great advance in the work done in plant breeding. The work carried on by the United States Department of Agriculture, under the immediate direction of Dr. Webber, is of inestimable value; and the "new creations" in fruits and flowers which periodically appear in the garden of Luther Burbank at Santa Rosa, California, have attracted world wide attention. But the mere production of new forms of intrinsic value is not the only work in hand. It is now coming to be recognized that many diseases of plants are due to some, often times it may be slight, lack of adaptation to conditions and surroundings. The plants are "out of tune" with their

environment, and this lack of adaptation, though slight, may make the difference between profit and loss in the returns from a given crop. The disease known as *couloure,* or the falling of the flowers and young fruit of certain of the finest raisin grapes in California is a case in point. An investigation by officers of the Department of Agriculture has shown that this trouble is mainly due to unfavorable climatic conditions at the time of blooming. If, now, the time of blooming should be delayed somewhat until the season of settled weather, or if the varieties should be rendered slightly hardier, so as to resist the unfavorable conditions, a service of untold benefit would be rendered to the raisin industry of California. In the attempt to meet the emergency, some 20 thousand crosses have been made between the two best raisin grapes—Muscat of Alexandria and Muscatel Gordo Blanco—with the Malaga, a vigorous, hardy, thrifty sort which, though an excellent raisin grape, is inferior to the sorts named.* As the seedlings resulting from these crosses come into fruitage the hardiest and most resistant types will be selected in the hope of securing the desired end.

A similar problem confronts the growers of citrus fruits in Florida and Louisiana,—a fact again emphasized by the recent severe losses from freezing. Here, again, the Department of Agriculture is doing an important work in crossing the more valuable varieties of the orange with the *Citrus trifoliata,* which is hardy as far north as Philadelphia. Several hundred hybrids have been produced and are now growing; many of them showing varieties intermediate in character. Of course the end in view is to secure, by a sufficient number of crosses, a variety which shall combine the good qualities of the common orange with the hardiness of the trifoliate parent. The same method may be looked to in the production of hardier varieties of other subtropical fruits.

Another problem in citrus culture is the production of an orange with the skin of a tangerine. Hybrid seedlings to the number of a thousand or more have been produced, and results are awaited with interest. The breeding of pine-apples of superior quality, and resistant to disease, is also receiving special attention in the subtropical laboratory of the Bureau of Plant Industry, the crosses of this fruit running up into the thousands.

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* Yearbook, U. S. Dept. of Agriculture, 1898, 265.

In pear growing it is very important to combine the disease resisting qualities of the Oriental varieties with the highest quality of fruit of the European sorts. Some hundreds of crosses have been made with this in view.

In plum culture, especially in northern New England, the same problem is met. In former years plum growing was an extensive industry in the Penobscot valley, but the dreaded black knot drove the industry out of the country. Is it possible, by crossing with the Japanese varieties, which seem less subject to the attack of this disease, to produce sorts which, while resistant to disease, shall be hardy enough to resist the severe winter?

Cherries also, in years past, have formed an important item in the income of fruit growers along the Kennebec. But the demand for sour cherries in the Boston markets is limited, and the hearts and biggarreaus are very uncertain in point of hardiness. Most of the cherries for which Hallowell and Gardiner have been locally noted in the past, were seedlings of Black Tartarian. But these seedlings are very uncertain and are frequently killed back by severe winters. With a view to combining the vigor and hardiness of the sour cherries with the good qualities of the fruit of the sweet sorts, Card of Rhode Island, has made numerous crosses. A large proportion of the sour cherries crossed by the sweet varieties matured fruit which apparently was normal. Curiously enough, however, the reciprocal crosses in every instance failed to mature fruit; * and in a personal letter to the writer, Professor Card writes that in only two instances was he able to secure germination from the crosses made—and these seedlings met with an accident and were lost.

Apples, quinces, peaches and the various small fruits, are all, without doubt, capable of producing disease resisting forms which shall do away, in a measure at least, with the expense and labor of spraying and otherwise combating the numerous fungous pests with which the orchardist must contend.

While the reigning types of native fruits are the result, largely, of the force of circumstances rather than the direct choice of man, an intelligent choice of species and of forms has, nevertheless, played an important part in the evolution of these types, and it may play a still more important part in the years to come.

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* Rpt. R. I. Expt. Station, 1899, 130.

As suggested at the beginning of this discussion, plant breeding in its relation to pomology has as yet been largely fortuitous. Little study of fundamental laws has been made. Thousands of crosses have been made and hundreds of thousands of seedlings have been produced, but the work has been largely without definite ideals in view, and without a view of probable means of reaching an ideal. In the judgment of the writer, the problems of propagation, environment, and individual variation are of quite as much importance, and are certainly as little understood, as are the obscure problems of cytological variations and combinations.

Many years ago Thomas Andrew Knight popularized the method of root grafting, and the question of the mutual influence of cion and stock has long been a fertile one for discussion. Nevertheless little accurate work has been done in studying the problems thus involved.

It is known, in a general way, that certain chemicals have specific effects upon the color, composition or other characteristics of fruits, but acurate data in this direction are scarce. The fact of individuality in fruit plants is recognized, but its importance as a factor in the development of a type has been almost wholly overlooked.

The fact of the existence of graft hybrids is freely maintained, but the principles involved in the production of such forms remain a closed book.

In the past most discussions of pomological problems have been empirical. There are certain principles underlying the subject, however, which, in common with the improvement of plants in general, are fundamental and far reaching in their importance. It is to this class of problems, more scientific but not less practical in their nature, that pomologists and plant breeders alike are devoting thought and study at the present time. The solution of some of these problems, and the classification of knowledge concerning the subject, is necessary in order to raise pomology to the rank of a distinct science.

FERTILIZER INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of Inspection Analyses.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

The analyses of the manufacturers' samples for this year were published in March. A number of samples were received so late that the analyses could not be included in the bulletin then issued. The results of these analyses are given in the tables on page 194.

In the tables that immediately follow, the analyses of the samples of commercial fertilizers collected in the open market in the spring of 1906 by the Station representative are given. As far as possible two samples of each brand were taken, an effort being made to get the duplicate from a distinct lot of the same brand in a different part of the State. For the most part the samples were taken in the large warehouses where a large amount of the goods were stored as received from the factory. They were taken in almost every instance from a large number of packages and in the presence of a representative of the manufacturers. The law requires that a duplicate sample be left with the dealer or agent for the use of the manufacturer in case the accuracy of the Station analysis is questioned. As this duplicate sample has been used only twice by the manufacturers in the past ten years they, with the understanding that they could have a portion of the Station sample if they should wish for it, kindly waived their right to the reserve sample for the present year. This is a saving in the time of the inspector and in the number of sampling jars that he needs to take with him.

[Continued on page 195.]

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
	AMERICAN AGRICULTURAL CHEMICAL COMPANY, NEW YORK, N. Y.
1251	A. A. C. Company, Aroostook Complete Manure
1253	A. A. C. Company, Aroostook Complete Manure
1254	A. A. C. Company, Aroostook High Grade
1256	Bradley's Alkaline Bone with Potash
1257	Bradley's Alkaline Bone with Potash
1258	Bradley's Complete Manure for Potatoes and Vegetables
1259	Bradley's Complete Manure for Potatoes and Vegetables
1261	Bradley's Complete Manure with 10% Potash
1262	Bradley's Complete Manure with 10% Potash
1264	Bradley's Corn Phosphate
1265	Bradley's Corn Phosphate
1267	Bradley's Eureka Fertilizer
1268	Bradley's Eureka Fertilizer
1270	Bradley's Niagara Phosphate
1271	Bradley's Niagara Phosphate
1273	Bradley's Potato Fertilizer
1274	Bradley's Potato Fertilizer
1276	Bradley's Potato Manure
1277	Bradley's Potato Manure
1279	Bradley's X. L. Superphosphate of Lime
1280	Bradley's X. L. Superphosphate of Lime
1281	Clark's Cove Bay State Fertilizer
1282	Clark's Cove Bay State Fertilizer
1283	Clark's Cove Bay State Fertilizer G. G
1284	Clark's Cove Bay State Fertilizer for Seeding Down
1285	Clark's Cove Bay State Fertilizer for Seeding Down
1286	Clark's Cove Defiance Complete Manure
1287	Clark's Cove Defiance Complete Manure
1288	Clark's Cove Great Planet Manure, A. A
1289	Clark's Cove Great Planet Manure, A. A
1290	Clark's Cove King Philip Alkaline Guano
1291	Clark's Cove Potato Fertilizer
1292	Clark's Cove Potato Fertilizer
1293	Clark's Cove Potato Manure
1294	Clark's Cove Potato Manure
1295	Cleveland Fertilizer for all Crops
1296	Cleveland Fertilizer for all Crops
1297	Cleveland High Grade Complete Manure
1298	Cleveland Potato Phosphate
1299	Cleveland Potato Phosphate
1301	Cleveland Seeding Down Fertilizer
1302	Cleveland Seeding Down Fertilizer
1303	Cleveland Superphosphate
1304	Cleveland Superphosphate
1305	Complete Manure with 10% Potash

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
1251	1.35	1.18	2.53	2.47	2.27	4.94	1.91	7.21	6.00	9.12	......	10.38	10.00
1253	1.23	1.36	2.59	2.47	3.94	3.18	1.75	7.12	6.00	8.87	......	10.04	10.00
1254	1.69	2.66	4.35	4.12	3.96	4.19	1.37	8.15	7.00	9.52	......	6.31	7.00
1256	......	......	......	......	3.72	7.37	1.61	11.09	11.00	12.70	12.00	2.04	2.00
1257	......	......	......	......	6.78	4.51	1.25	11.29	11.00	12.54	12.00	2.16	2.00
1258	1.73	1.36	3.09	3.30	4.53	3.87	1.22	8.40	8.00	9.62	9.00	7.01	7.00
1259	1.91	1.54	3.45	3.30	5.39	3.59	1.20	8.98	8.00	10.18	9.00	6.58	7.00
1261	1.81	1.50	3.31	3.30	4.31	2.66	1.15	6.97	6.00	8.12	7.00	9.72	10.00
1262	2.13	1.28	3.41	3.30	4.27	2.83	1.16	7.10	6.00	8.26	7.00	9.87	10.00
1264	1.42	0.86	2.28	2.06	4.94	3.52	2.45	8.46	8.00	10.91	10.00	2.06	1.50
1265	1.03	1.06	2.09	2.06	5.12	3.45	2.00	8.57	8.00	10.57	10.00	2.07	1.50
1267	0.70	0.62	1.32	1.03	5.58	2.68	1.24	8.26	8.00	9.50	10.00	2.16	2.00
1268	0.45	0.62	1.07	1.03	5.12	3.72	1.94	8.84	8.00	10.78	10.00	2.12	2.00
1270	0.25	0.80	1.05	0.82	4.82	3.95	0.96	8.77	7.00	9.73	8.00	1.79	1.00
1271	0.57	0.76	1.33	0.82	5.49	4.03	1.33	9.52	7.00	10.85	8.00	2.15	1.00
1273	1.09	0.98	2.07	2.06	3.49	6.33	2.27	9.82	8.00	12.09	10.00	3.05	3.00
1274	1.47	0.66	2.13	2.06	6.49	2.62	2.17	9.11	8.00	11.28	10.00	3.04	3.00
1276	1.04	1.54	2.58	2.50	3.00	3.55	1.94	6.55	6.00	8.49	8.00	5.08	5.00
1277	1.44	1.19	2.63	2.50	3.19	3.79	2.33	6.98	6.00	9.31	8.00	4.94	5.00
1279	1.53	1.10	2.63	2.50	6.11	3.62	2.14	9.73	9.00	11.87	11.00	2.52	2.00
1280	1.31	1.16	2.47	2.50	6.28	2.51	2.93	8.79	9.00	11.72	11.00	2.28	2.00
1281	1.36	1.25	2.61	2.50	5.57	3.07	2.88	8.64	9.00	11.52	11.00	2.35	2.00
1282	1.40	1.16	2.56	2.50	6.12	3.15	2.42	9.27	9.00	11.69	11.00	2.80	2.00
1283	1.21	0.88	2.09	2.06	4.50	3.44	2.55	7.94	8.00	10.49	10.00	1.95	1.50
1284	0.38	0.84	1.12	1.03	5.02	3.30	1.12	8.32	8.00	9.44	10.00	1.90	2.00
1285	0.42	0.72	1.15	1.03	5.90	2.62	2.23	8.52	8.00	10.75	10.00	2.19	2.00
1286	0.40	0.96	1.36	0.82	5.68	2.56	2.33	8.24	7.00	10.57	8.00	2.21	1.00
1287	0.65	0.78	1.43	0.82	5.06	2.78	2.73	7.84	7.00	10.57	8.00	2.38	1.00
1288	2.22	1.34	3.56	3.30	3.08	4.63	3.42	7.71	8.00	11.13	9.00	7.72	7.00
1289	1.75	1.48	3.23	3.30	5.90	2.41	2.04	8.31	8.00	10.35	9.00	7.48	7.00
1290	0.36	0.74	1.10	1.03	5.81	2.67	2.41	8.48	8.00	10.89	10.00	2.09	2.00
1291	1.01	1.08	2.09	2.06	5.18	2.75	2.72	7.93	8.00	10.65	10.00	3.49	3.00
1292	1.02	1.00	2.02	2.06	3.62	4.97	2.78	8.59	8.00	11.37	10.00	3.23	3.00
1293	1.13	1.14	2.27	2.50	2.33	4.33	2.70	6.66	6.00	9.36	8.00	5.14	5.00
1294	1.10	1.86	2.96	2.50	4.86	2.63	2.25	7.49	6.00	9.74	8.00	5.83	5.00
1295	0.84	0.81	1.65	1.03	5.47	2.53	2.59	8.00	8.00	10.59	10.00	2.03	2.00
1296	0.55	0.56	1.11	1.03	4.96	3.46	2.17	8.42	8.00	10.59	10.00	2.82	2.00
1297	1.37	1.58	2.95	3.30	5.55	2.61	2.17	8.16	8.00	10.33	9.00	7.91	7.00
1298	1.12	0.96	2.08	2.06	5.34	2.62	2.90	7.96	8.00	10.86	10.00	3.04	3.00
1299	1.29	0.92	2.21	2.06	3.05	5.16	3.29	8.21	8.00	11.50	10.00	3.23	3.00
1301	0.23	0.82	1.05	1.03	4.26	4.04	2.77	8.30	8.00	11.07	10.00	2.12	2.00
1302	0.51	0.66	1.17	1.03	5.38	2.94	2.37	8.32	8.00	10.69	10.00	2.08	2.00
1303	1.16	1.01	2.17	2.06	4.66	3.13	2.82	7.79	8.00	10.61	10.00	1.95	1.50
1304	1.06	1.06	2.12	2.06	3.03	4.32	2.81	7.35	8.00	10.16	10.00	1.74	1.50
1305	2.00	1.17	3.17	3.30	3.84	2.58	0.71	6.42	6.00	7.13	7.00	9.85	10.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1307	Crocker's Ammoniated Corn Phosphate
1308	Crocker's Ammoniated Corn Phosphate
1309	Crocker's Aroostook Potato Special
1310	Crocker's Aroostook Potato Special
1311	Crocker's Grass and Oats Fertilizer
1312	Crocker's Grass and Oats Fertilizer
1314	Crocker's High Grade
1316	Crocker's New Rival Ammoniated Superphosphate
1317	Crocker's New Rival Ammoniated Superphosphate
1318	Crocker's Potato, Hop and Tobacco
1320	Crocker's Potato, Hop and Tobacco
1322	Crocker's Special Potato Manure
1323	Crocker's Special Potato Manure
1324	Cumberland Guano for all Crops
1326	Cumberland Potato Fertilizer
1327	Cumberland Potato Fertilizer
1328	Cumberland Seeding Down Manure
1329	Cumberland Seeding Down Manure
1330	Cumberland Superphosphate
1331	Cumberland Superphosphate
1332	Darling's Blood Bone and Potash
1333	Fine Ground Bone
1334	Grass and Lawn Top Dressing
1335	Great Eastern General Fertilizer
1336	Great Eastern General Fertilizer
1338	Great Eastern Grass and Oats Fertilizer
1339	Great Eastern Grass and Oats Fertilizer
1341	Great Eastern High Grade Potato Manure
1342	Great Eastern High Grade Potato Manure
1344	Great Eastern Northern Corn Special
1345	Great Eastern Northern Corn Special
1347	Great Eastern Potato Manure
1348	Great Eastern Potato Manure
1349	Great Eastern Potato Special
1351	High Grade Fertilizer with 10% Potash
1352	High Grade Fertilizer with 10% Potash
1353	High Grade Sulphate of Potash
1354	Lazaretto Aroostook Potato Guano
1355	Lazaretto Corn Guano
1356	Lazaretto High Grade Potato Manure
1357	Lazaretto High Grade Potato Manure
1358	Lazaretto Propellor Potato Guano
1360	Muriate of Potash
1361	Nitrate of Soda
1362	Otis' Potato Fertilizer

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1307	1.21	0.84	2.05	2.06	4.42	3.44	2.81	7.86	8.00	10.67	......	1.98	1.50
1308	1.20	1.13	2.33	2.06	5.23	2.97	1.85	8.20	8.00	10.05	......	1.76	1.50
1309	0.88	1.12	2.00	2.06	5.33	3.30	2.77	8.63	8.00	11.40	......	6.00	6.00
1310	1.27	0.74	2.01	2.06	6.22	2.54	2.26	8.76	8.00	11.02	......	5.79	6.00
1311	......	......	......	......	5.26	5.37	1.95	10.63	11.00	12.58	......	2.23	2.00
1312	......	......	......	......	6.27	4.26	1.75	10.53	11.00	12.28	......	2.06	2.00
1314	1.71	1.52	3.23	3.29	4.58	3.57	1.91	8.15	8.00	10.06	......	6.58	7.00
1316	0.48	0.82	1.30	1.03	2.39	5.82	3.07	8.21	8.00	11.28	......	2.34	2.00
1317	0.58	0.74	1.32	1.03	4.75	3.61	2.49	8.36	8.00	10.85	......	2.27	2.00
1318	1.07	1.04	2.11	2.06	3.88	3.98	2.55	7.86	8.00	10.41	......	2.90	3.00
1320	0.89	1.08	1.97	2.06	4.91	3.22	1.84	8.13	8.00	9.97	......	3.31	3.00
1322	1.82	1.42	3.24	3.29	3.03	4.51	3.11	7.54	6.00	10.65	......	11.08	10.00
1323	2.12	1.30	3.42	3.29	2.28	3.64	3.39	5.92	6.00	9.31	......	10.73	10.00
1324	0.26	0.78	1.04	1.03	5.65	3.14	1.88	8.79	8.00	10.67	10.00	2.29	2.00
1326	1.35	0.94	2.29	2.06	3.19	4.95	3.23	8.14	8.00	11.37	10.00	3.44	3.00
1327	1.42	0.72	2.14	2.06	6.67	2.21	1.93	8.88	8.00	10.81	10.00	3.24	3.04
1328	0.36	0.78	1.14	1.03	5.61	3.18	1.62	8.79	8.00	10.41	10.00	2.23	2.00
1329	0.42	0.72	1.14	1.03	4.75	4.63	1.75	9.38	8.00	11.13	10.00	2.26	2.00
1330	1.30	0.88	2.18	2.06	3.81	4.31	2.36	8.12	8.00	10.48	10.00	2.53	1.50
1331	1.19	0.88	2.07	2.06	4.56	3.06	3.11	7.62	8.00	10.73	10.00	2.34	1.50
1332	2.58	1.74	4.32	4.10	3.09	3.60	2.62	6.69	7.00	9.31	8.00	8.09	7.00
1333	......	......	2.13	2.47	......	......	......	......	......	27.87	22.80	......	......
1334	4.89	0.04	4.93	3.91	1.28	4.56	1.34	5.84	5.00	7.18	6.00	2.62	2.00
1335	0.44	0.58	1.02	0.82	3.54	4.12	2.64	7.66	8.00	10.30	.....	3.73	4.00
1336	0.49	0.46	0.95	0.82	4.86	2.58	2.72	7.44	8.00	10.16	......	4.01	4.00
1338	......	......	......	......	4.67	6.02	2.04	10.69	11.00	12.73	......	2.10	2.00
1339	......	......	......	......	3.52	7.01	2.93	10.53	11.00	13.46	......	2.02	2.00
1341	2.01	1.52	3.53	3.29	3.60	3.87	2.42	7.47	6.00	9.89	......	10.19	10.00
1342	1.41	2.02	3.43	3.29	4.69	2.60	1.66	7.29	6.00	8.95	......	10.07	10.00
1344	1.56	0.82	2.38	2.06	5.15	3.55	2.21	8.70	8.00	10.91	......	2.24	1.50
1345	1.49	0.92	2.41	2.06	4.12	4.78	2.65	8.90	8.00	11.55	......	1.88	1.50
1347	1.21	0.86	2.07	2.06	4.58	3.79	3.02	8.37	8.00	11.39	......	3.40	3.00
1348	0.82	1.32	2.14	2.06	5.41	2.83	2.11	8.24	8.00	10.35	......	3.25	3.00
1349	1.91	1.44	3.35	3.29	5.57	2.88	2.08	8.45	8.00	10.53	......	7.32	7.00
1351	1.33	1.38	2.71	2.40	1.99	3.64	1.56	5.63	6.00	7.19	7.00	10.03	10.00
1352	1.33	1.18	2.51	2.40	4.47	2.85	0.97	7.32	6.00	8.29	7.00	10.49	10.00
1353	......	......	......	......	......	......	......	......	......	......	......	45.28	48.00
1354	0.44	0.54	0.98	0.82	5.15	3.15	2.21	8.30	8.00	10.51	......	4.06	4.00
1355	0.72	1.44	2.16	1.64	4.61	2.81	2.55	7.42	8.00	9.97	......	2.37	2.00
1356	1.91	1.34	3.25	3.29	3.62	2.58	2.25	6.20	6.00	8.45	......	10.18	10.00
1357	2.17	1.34	3.51	3.29	2.87	3.13	2.93	6.00	6.00	8.93	......	10.98	10.00
1358	0.87	1.18	2.05	2.06	5.53	2.63	2.64	8.16	8.00	10.80	......	5.62	6.00
1360	......	......	......	......	......	......	......	......	......	......	......	50.60	50.00
1361	15.69	......	15.69	15.80	......	......	......	......	......	......	......	......	......
1362	1.35	0.68	2.03	2.06	6.30	2.16	1.80	8.46	8.00	10.26	10.00	3.11	3.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1363	Otis' Seeding Down Fertilizer
1364	Otis' Superphosphate
1365	Pacific Dissolved Bone and Potash
1366	Pacific Dissolved Bone and Potash
1368	Pacific Grass and Grain Fertilizer
1369	Pacific Grass and Grain Fertilizer
1370	Pacific High Grade General Fertilizer
1371	Pacific Nobsque Guano
1372	Pacific Potato Special
1373	Pacific Potato Special
1375	Packer's Union Animal Corn Fertilizer
1376	Packer's Union Animal Corn Fertilizer
1377	Packer's Union Economical Vegetable Guano
1378	Packer's Union Economical Vegetable Guano
1379	Packer's Union Gardener's Complete Manure
1380	Packer's Union High Grade
1382	Packer's Union Potato Manure
1383	Packer's Union Potato Manure
1384	Packer's Union Universal Fertilizer
1385	Packer's Union Universal Fertilizer
1387	Packer's Union, Wheat, Oats and Clover Fertilizer
1388	Packer's Union, Wheat, Oats and Clover Fertilizer
1389	Plain Superphosphate
1390	Quinnipiac Climax Phosphate for all Crops
1391	Quinnipiac Climax Phosphate for all Crops
1392	Quinnipiac Corn Manure
1393	Quinnipiac Corn Manure
1394	Quinnipiac Market Garden Manure
1395	Quinnipiac Market Garden Manure
1396	Quinnipiac Mohawk Fertilizer
1397	Quinnipiac Potato Manure
1398	Quinnipiac Potato Manure
1399	Quinnipiac Potato Phosphate
1400	Quinnipiac Potato Phosphate
1401	Read's Farmers' Friend Superphosphate
1402	Read's Farmers' Friend Superphosphate
1403	Read's High Grade Farmers' Fertilizer
1404	Read's Potato Manure
1405	Read's Practical Potato Special
1406	Read's Practical Potato Special
1407	Read's Standard Superphosphate
1408	Read's Standard Superphosphate
1411	Read's Sure Catch Fertilizer
1412	Read's Sure Catch Fertilizer
1413	Read's Vegetable and Vine Fertilizer

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
1363	0.60	0.57	1.17	1.03	5.33	3.21	2.40	8.54	8.00	10.94	10.00	2.22	2.00
1364	1.23	1.00	2.23	2.06	4.59	4.60	2.53	9.19	8.00	11.72	10.00	1.96	1.50
1365	......	......	......	......	6.35	4.00	1.68	10.35	10.00	12.03	11.00	2.09	2.00
1366	......	......	......	......	3.64	6.60	2.46	10.24	10.00	12.70	11.00	2.08	2.00
1368	0.21	0.68	0.99	0.82	3.59	3.00	1.94	6.59	7.00	8.53	8.00	1.75	1.00
1369	0.60	0.72	1.32	0.82	2.81	4.51	2.63	7.32	7.00	9.95	8.00	1.27	1.00
1370	1.87	1.30	3.17	3.30	5.63	2.71	2.25	8.34	8.00	10.59	9.00	7.07	7.00
1371	0.22	0.90	1.12	1.03	5.66	2.84	1.98	8.50	8.00	10.48	10.00	2.29	2.00
1372	1.11	0.96	2.07	2.06	4.71	3.03	3.15	7.74	8.00	10.89	10.00	3.66	3.00
1373	1.03	1.04	2.07	2.06	4.12	3.25	2.33	7.37	8.00	9.70	10.00	3.18	3.00
1375	1.34	1.18	2.52	2.47	5.63	4.14	2.53	9.77	9.00	12.30	......	2.44	2.00
1376	1.18	1.30	2.48	2.47	5.45	2.30	2.56	8.75	9.00	11.31	......	2.32	2.00
1377	0.83	0.56	1.39	1.25	3.99	2.85	2.65	6.84	6.00	9.49	......	3.87	3.00
1378	0.51	0.84	1.35	1.25	3.51	2.97	1.85	6.48	6.00	8.33	......	5.12	3.00
1379	0.97	1.50	2.47	2.47	1.29	5.38	1.91	6.67	6.00	8.58	.....	10.26	10.00
1380	2.03	1.22	3.25	3.29	5.85	2.63	1.81	8.48	8.00	10.29	......	7.27	7.00
1382	0.85	1.18	2.03	2.06	5.69	2 83	2.21	8.52	8.00	10.73	......	6.12	6.00
1383	1.42	0.98	2.40	2.06	4.18	5.53	2.70	9.71	8.00	12.41	......	6.69	6.00
1384	0.61	0.44	1.05	0.82	5.38	3.43	2.21	8.81	8.00	11.02	......	3.85	4.00
1385	0.66	0.76	1.42	0.82	4.24	3.45	2.64	7.69	8.00	10.33	......	4.51	4.00
1387	......	......	......	......	6.86	3.22	2.11	10.08	11.00	12.19	......	2.08	2.00
1388	......	......	......	......	3.08	9.17	1.47	12.25	11.00	13.72	......	2.81	2.00
1389	......	......	......	......	5.90	9.32	2.48	15.22	14.00	17.70	15.00	......	......
1390	0.15	0.86	1.01	1.03	5.47	3.18	1.30	8.65	8.00	9.95	10.00	1.84	2.00
1391	0.79	0.56	1.35	1.03	5.50	3.05	2.49	8.55	8.00	11.04	10.00	2.26	2.00
1392	0.89	1.22	2.11	2.06	3.22	5.67	1.88	8.89	8.00	10.77	10.00	1.66	1.50
1393	1.11	1.04	2.15	2.06	4.85	3.51	2.25	8.36	8.00	10.61	10.00	2.80	1.50
1394	1.77	1.40	3.17	3.30	5.77	2.64	2.36	8.41	8.00	10.77	9.00	7.49	7.00
1395	1.89	1.60	3.49	3.30	3.83	4.09	2.14	7.92	8.00	10.06	9.00	7.07	7.00
1396	0.47	0.75	1.22	0.82	5.10	3.29	2.42	8.39	7.00	10.81	8.00	2.29	1.00
1397	1.15	1.36	2.51	2.50	3.08	3.45	2.02	6.53	6.00	8.55	8.00	4.78	5.00
1398	1.05	1.62	2.67	2.50	4.96	3.69	1.89	8.65	6.00	10.54	8.00	5.33	5.00
1399	1.06	0.96	2.02	2.06	3.29	5.76	2.77	9.05	8.00	11.82	10.00	3.43	3.00
1400	1.15	1.00	2.15	2.06	3.57	5.06	2.87	8.63	8.00	11.50	10.00	3.28	3.00
1401	1.07	0.94	2.01	2.06	3.64	4.71	3.09	8.35	8.00	11.44	10.00	3.42	3.00
1402	1.04	1.02	2.06	2.06	5.45	3.05	2.31	8.50	8.00	10.81	10.00	4.10	3.00
1403	2.01	1.30	3.31	3.30	4.04	2.51	0.83	6.55	6.00	7.38	7.00	9.73	10.00
1404	1.11	1.48	2.59	2.47	2.25	3.85	2.75	6.10	6.00	8.85	7.00	9.76	10.00
1405	0.60	0.42	1.02	0.82	3.96	2.44	2.32	6.40	5.00	8.72	5.00	6.42	8.00
1406	0.53	0.56	1.09	0.82	2.09	3.24	2.05	5.33	4.00	7.38	5.00	6.88	8.00
1407	0.39	0.64	1.03	0.82	3.92	4.03	2.13	7.95	8.00	10.08	10.00	3.94	4.00
1408	0.32	0.66	0.98	0.82	4.42	3.48	2.33	7.90	8.00	9.23	10.00	3.96	4.00
1411	......	......	......	......	4.50	5.12	2.14	9.62	10.00	11.76	11.00	2.04	2.00
1412	......	......	......	......	5.71	4.05	2.67	9.76	10.00	12.43	11.00	2.08	2.00
1413	1.09	1.14	2.23	2.06	4.88	3.63	2.40	8.51	8.00	10.91	10.00	4.95	6.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1414	Read's Vegetable and Vine Fertilizer
1416	Soluble Pacific Guano
1417	Soluble Pacific Guano
1419	Standard A. Brand
1420	Standard A. Brand
1422	Standard Bone and Potash
1423	Standard Bone and Potash
1424	Standard Complete Manure
1425	Standard Complete Manure
1426	Standard Fertilizer
1427	Standard Fertilizer
1428	Standard Guano for all Crops
1429	Standard Guano for all Crops
1431	Standard Special for Potatoes
1432	Standard Special for Potatoes
1433	Williams & Clark's Americus Ammoniated Bone Superphosphate
1435	Williams & Clark's Americus Corn Phosphate
1436	Williams & Clark's Americus Corn Phosphate
1437	Williams & Clark's Americus High Grade Special
1438	Williams & Clark's Americus High Grade Special
1441	Williams & Clark's Americus Potato Manure
1442	Williams & Clark's Americus Potato Manure
1443	Williams & Clark's Royal Bone Phosphate for all Crops
1444	Williams & Clark's Royal Bone Phosphate for all Crops
	ARMOUR FERTILIZER WORKS, BALTIMORE, MD.
1450	Armour's All Soluble
1451	Armour's All Soluble
1452	Armour's Bone, Blood and Potash
1453	Armour's Bone, Blood and Potash
1454	Armour's Fruit and Root Crop Special
1455	Armour's Grain Grower
1456	Armour's Grain Grower
1457	Armour's High Grade Potato Fertilizer
1458	Armour's High Grade Potato Fertilizer
1459	Armour's Wheat, Corn and Oats Special Fertilizer
	BOWKER FERTILIZER COMPANY, BOSTON, MASS.
1464	Bowker's Bone, Blood and Potash
1465	Bowker's Bone, Blood and Potash
1468	Bowker's Bone and Potash Square Brand
1469	Bowker's Bone and Potash Square Brand
1470	Bowker's Corn Phosphate
1471	Bowker's Corn Phosphate
1473	Bowker's Early Potato Manure
1474	Bowker's Early Potato Manure
1475	Bowker's Farm and Garden Phosphate
1476	Bowker's Farm and Garden Phosphate
1477	Bowker's Fresh Ground Bone
1479	Bowker's Hill and Drill Phosphate

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1414	0.78	1.23	2.01	2.06	5.63	2.54	2.28	8.17	8.00	10.45	10.00	5.37	6.00
1416	1.19	0.94	2.13	2.06	4.74	3.17	2.82	7.91	8.00	10.73	10.00	2.02	1.50
1417	1.11	0.96	2.07	2.06	4.67	3.93	2.36	8.60	8.00	10.96	10.00	1.97	1.50
1419	0.48	0.60	1.08	0.82	5.60	2.81	2.58	8.41	7.00	10.99	8.00	2.03	1.00
1420	0.56	0.74	1.30	0.82	3.33	4.33	2.67	7.66	7.00	10.33	8.00	1.31	1.00
1422	......	......	......	......	4.15	6.18	2.67	10.33	10.00	13.00	11.00	2.05	2.00
1423	......	......	......	.....	3.96	7.30	2.58	11.26	10.00	13.84	11.00	2.01	2.00
1424	2.01	1.57	3.58	3.30	4.18	3.84	2.03	8.02	8.00	10.05	9.00	7.02	7.00
1425	1.79	1.40	3.19	3.30	5.52	2.84	2.55	8.36	8.00	10.91	9.00	7.74	7.00
1426	1.31	0.94	2.25	2.06	5.02	3.05	3.62	8.07	8.00	11.69	10.00	1.97	1.50
1427	0.98	1.26	2.24	2.06	2.86	5.02	2.07	7.88	8.00	9.95	10.00	1.74	1.50
1428	0.56	0.62	1.18	1.03	5.33	2.81	1.38	8.14	8.00	9.52	10.00	2.14	2.00
1429	0.55	0.72	1.27	1.03	5.58	2.64	2.90	8.22	8.00	11.12	10.00	2.14	2.00
1431	0.93	1.08	2.01	2.06	5.71	2.54	2.63	8.25	8.00	10.88	10.00	2.85	3.00
1432	1.37	0.90	2.27	2.06	3.09	5.11	4.21	8.20	8.00	12.41	10.00	3.29	3.00
1433	1.51	0.92	2.43	2.50	6.59	2.70	2.99	9.29	9.00	12.28	11.00	2.25	2.00
1435	1.14	0.96	2.10	2.06	4.37	3.68	2.73	8.05	8.00	10.78	10.00	2.01	1.50
1436	1.48	0.78	2.26	2.06	5.06	3.18	3.23	8.24	8.00	11.47	10.00	1.93	1.50
1437	1.79	1.46	3.25	3.30	6.28	2.08	2.02	8.36	8.00	10.38	9.00	6.85	7.00
1438	1.88	1.47	3.35	3.30	5.66	3.09	2.02	8.75	8.00	10.77	9.00	7.45	7.00
1441	1.10	0.92	2.02	2.06	3.21	4.66	3.65	7.87	8.00	11.52	10.00	3.31	3.00
1442	1.43	0.66	2.09	2.06	6.00	2.32	2.77	8.32	8.00	11.09	10.00	3.18	3.00
1443	0.66	0.56	1.22	1.03	5.09	2.63	2.74	7.72	8.00	10.46	10.00	2.18	2.00
1444	0.56	0.54	1.10	1.03	5.68	2.47	2.62	8.15	8.00	10.77	10.00	2.18	2.00
1450	0.91	2.12	3.03	2.88	6.09	2.94	1.05	9.03	8.00	10.08	10.00	4.13	4.00
1451	1.21	1.18	2.39	2.88	6.62	3.24	1.19	9.86	8.00	11.05	10.00	3.91	4.00
1452	0.29	3.38	3.67	4.11	5.60	2.77	0.64	8.37	8.00	9.01	10.00	7.75	7.00
1453	1.81	2.32	4.13	4.11	6.12	1.39	1.02	7.51	8.00	8.35	10.00	9.04	7.00
1454	0.64	1.22	1.86	1.65	5.79	2.55	1.10	8.34	8.00	9.44	10.00	5.77	5.00
1455	0.86	0.81	1.67	1.65	5.65	2.70	1.30	8.35	8.00	9.65	10.00	2.07	2.00
1456	0.65	1.02	1.67	1.65	5.30	3.27	1.53	8.57	8.00	10.10	10.00	2.03	2.00
1457	0.69	0.89	1.58	1.65	5.93	2.69	0.84	8.62	8.00	9.46	10.00	9.39	10.00
1458	0.89	0.76	1.65	1.65	5.74	2.48	0.87	8.22	8.00	9.09	10.00	10.33	10.00
1459	0.15	0.77	0.92	1.82	3.32	4.78	1.79	8.10	7.00	9.89	9.00	1.03	1.00
1464	1.73	2.16	3.89	4.10	4.90	2.40	2.21	7.30	8.00	9.51	10.00	7.00	7.00
1465	2.55	1.60	4.15	4.10	4.83	3.08	1.82	7.91	8.00	9.73	10.00	7.03	7.00
1468	1.27	0.72	1.99	1.65	5.85	1.83	2.97	7.68	6.00	10.65	7.00	2.56	2.00
1469	0.49	1.60	2.09	1.65	5.45	2.57	2.19	8.02	6.00	10.21	7.00	2.02	2.00
1470	1.15	0.88	2.03	1.65	4.86	3.14	2.85	8.00	8.00	10.85	9.00	2.75	2.00
1471	0.27	1.72	1.99	1.65	4.83	2.73	2.54	7.56	8.00	10.10	9.00	2.16	2.00
1473	1.92	1.36	3.28	3.29	3.51	4.27	2.67	7.78	7.00	10.45	8.00	7.54	7.00
1474	1.95	1.50	3.45	3.29	5.06	2.49	2.50	7.55	7.00	10.05	8.00	7.58	7.00
1475	1.23	1.72	1.95	1.65	4.93	3.16	3.07	8.09	8.00	11.16	9.00	2.45	2.00
1476	0.95	0.86	1.81	1.65	3.22	4.78	2.21	8.00	8.00	10.21	9.00	2.08	2.00
1477	......	......	2.66	2.47	......	......	......	......	......	24.00	18.00	......	......
1479	1.54	0.88	2.42	2.47	6.01	3.26	3.00	9.27	9.00	12.27	10.00	2.30	2.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1480	Bowker's Hill and Drill Phosphate
1481	Bowker's Market Garden Fertilizer
1482	Bowker's Market Garden Fertilizer
1484	Bowker's Potash Bone
1486	Bowker's Potash or Staple Phosphate
1488	Bowker's Potato and Vegetable Fertilizer
1489	Bowker's Potato and Vegetable Fertilizer
1491	Bowker's Potato and Vegetable Phosphate
1492	Bowker's Potato and Vegetable Phosphate
1493	Bowker's Six Per Cent Potato Fertilizer
1494	Bowker's Six Per Cent Potato Fertilizer
1496	Bowker's Superphosphate with Potash for Grass and Grain
1497	Bowker's Superphosphate with Potash for Grass and Grain
1498	Bowker's Sure Crop Phosphate
1499	Bowker's Sure Crop Phosphate
1500	Bowker's Ten Per Cent Manure
1501	Monticello Grange Chemicals
1502	Special Potato Manure for the Grange
1503	Stockbridge Special Manure for Corn (Class D 107)
1504	Stockbridge Special Manure for Corn (Class D 107)
1506	Stockbridge's Special Manure for Grass (Class F 56)
1507	Stockbridge's Special Manure for Grass (Class F 56)
1509	Stockbridge's Special Manure for Potatoes (Class D 610)
1510	Stockbridge's Special Manure for Potatoes (Class D 610)
1511	Stockbridge's Special Manure for Seeding Down (Class C 610)
	COE-MORTIMER COMPANY, NEW YORK, N. Y.
1518	E. Frank Coe's Celebrated Special Potato Fertilizer
1519	E. Frank Coe's Celebrated Special Potato Fertilizer
1521	E. Frank Coe's Columbian Corn Fertilizer
1522	E. Frank Coe's Columbian Corn Fertilizer
1524	E. Frank Coe's Columbian Potato Fertilizer
1525	E. Frank Coe's Columbian Potato Fertilizer
1527	F. Frank Coe's Excelsior Potato Fertilizer
1528	E. Frank Coe's Excelsior Potato Fertilizer
1529	E. Frank Coe's Grass and Grain Special Fertilizer
1530	E. Frank Coe's Grass and Grain Special Fertilizer
1531	E. Frank Coe's High Grade Ammoniated Bone Superphosphate
1532	E. Frank Coe's High Grade Ammoniated Bone Superphosphate
1533	E. Frank Coe's High Grade Potato Fertilizer
1534	E. Frank Coe's High Grade Potato Fertilizer
1536	E. Frank Coe's New Englander Corn Fertilizer
1537	E. Frank Coe's New Englander Corn Fertilizer
1539	E. Frank Coe's New Englander Potato Fertilizer
1540	E. Frank Coe's New Englander Potato Fertilizer
1542	E. Frank Coe's Prize Brand Grain and Grass
1543	E. Frank Coe's Prize Brand Grain and Grass
1545	E. Frank Coe's Red Brand Excelsior Guano

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1480	1.49	0.98	2.47	2.47	6.89	2.41	2.41	9.30	9.00	11.71	10.00	2.37	2.00
1481	1.29	1.44	2.73	2.47	1.36	5.15	2.17	6.51	6.00	8.68	7.00	10.15	10.00
1482	1.70	1.12	2.82	2.47	4.29	2.41	1.63	6.70	6.00	8.33	7.00	9.65	10.00
1484	0.52	0.64	1.16	0.82	5.87	2.94	2.32	8.81	6.00	11.13	7.00	2.11	2.00
1486	0.61	0.58	1.19	0.82	5.42	2.86	2.50	8.28	8.00	10.78	9.00	3.34	3.00
1488	1.73	1.02	2.75	2.47	5.07	3.50	3.70	8.57	8.00	12.27	10.00	4.32	4.00
1489	1.50	0.92	2.42	2.47	6.67	2.27	2.45	8.94	8.00	11.39	10.00	4.39	4.00
1491	0.87	0.86	1.73	1.65	5.84	2.81	2.44	8.65	9.00	11.09	10.00	2.08	2.00
1492	0.90	0.80	1.70	1.65	6.22	2.67	2.56	8.89	9.00	11.45	10.00	2.24	2.00
1493	0.82	0.68	1.50	0.82	4.18	2.91	2.40	7.09	6.00	9.49	7.00	7.27	6.00
1494	0.44	0.64	1.08	0.82	5.45	2.69	2.26	8.14	6.00	10.40	7.00	5.41	6.00
1496	......	......	.....	......	5.58	5.10	2.32	10.68	10.00	13.00	11.00	2.02	2.00
1497	......	......	......	......	6.94	3.18	0.85	10.12	10.00	10.97	11.00	1.76	2.00
1498	0.66	0.88	1.54	0.82	5.55	2.80	2.50	8.35	9.00	10.85	10.00	2.19	2.00
1499	0.44	0.70	1.14	0.82	5.82	2.98	2.27	8.80	9.00	11.07	10.00	2.12	2.00
1500	0.49	0.54	1.03	0.82	3.80	3.15	2.49	6.95	5.00	9.44	6.00	7.80	10.00
1501	0.96	1.56	2.52	2.50	6.41	1.81	1.11	8.22	8.00	9.33	12.00	4.01	4.00
1502	0.95	0.84	1.79	1.50	4.47	4.59	2.39	9.06	9.00	11.45	12.00	12.06	12.00
1503	0.87	2.54	3.41	3.29	2.95	5.93	5.00	8.88	10.00	13.88	11.00	6.29	7.00
1504	1.13	2.56	3.69	3.29	4.15	5.01	3.98	9.16	10.00	13.14	11.00	5.96	7.00
1506	1.90	3.20	5.10	4.94	4.90	1.74	2.16	6.64	4.00	8.80	6.00	6.83	6.00
1507	3.72	1.00	4.72	4.94	1.99	3.42	2.68	5.41	4.00	8.09	6.00	5.58	6.00
1509	1.75	1.28	3.03	3.29	4.16	2.12	1.10	6.28	6.00	7.38	7.00	9.95	10.00
1510	2.05	1.14	3.19	3.29	3.97	2.06	2.23	6.03	6.00	8.26	7.00	9.53	10.00
1511	1.23	1.22	2.45	2.47	4.04	2.97	2.08	7.01	6.00	9.09	9.00	10.40	10.00
1518	1.15	0.56	1.71	1.65	6.49	1.56	1.79	8.05	8.00	9.84	10.00	4.00	4.00
1519	1.19	0.54	1.73	1.65	6.52	1.87	1.71	8.39	8.00	10.10	10.00	3.84	4.00
1521	0.69	1.04	1.73	1.23	6.33	2.03	2.93	8.36	8.50	11.29	10.50	2.84	2.50
1522	0 45	0.96	1.41	1.23	5.71	2.26	2.70	7.97	8.50	10.67	10.50	2.73	2.50
1524	0.67	0.75	1.42	1.23	6.41	1.87	1.99	8.28	8.50	10.27	10.50	2.56	2.50
1525	0.86	0.56	1.42	1.23	7.19	1.90	2.12	9.09	8.50	11.21	10.50	2.90	2.50
1527	1.94	0.58	2.52	2.47	6.28	1.60	2.30	7.88	7.00	10.18	9.00	8.09	8.00
1528	1.88	0.78	2.66	2.47	5.57	1.14	1.74	6.71	7.00	8.45	9.00	8.68	8.00
1529	0.66	0.44	1.10	0.80	6.95	1.98	1.82	8.93	8.50	10.75	......	1.66	1.50
1530	0.64	0.44	1.08	0.80	6.95	2.15	2.27	9.10	8.50	11.37	......	1.67	1.50
1531	1.56	0.98	2.54	1.85	7.35	1.87	2.42	9.22	9.00	11.64	11.00	2.90	2.25
1532	1.03	0.80	1.83	1.85	7.02	2.01	3.33	9.03	9.00	12.36	11.00	2.64	2.25
1533	1.47	1.21	2.68	2.40	7.45	1.08	2.16	8.53	8.00	10.69	10.00	5.15	6.00
1534	1.48	1.06	2.54	2.40	6.62	1.52	1.68	8.14	8.00	9.82	10.00	6.22	6.00
1536	0.94	0.64	1.58	0.80	6.05	2.34	2.39	8.39	7.50	10.78	9.00	3.56	3.00
1537	0.83	0.58	1.41	0.80	5.69	2.47	4.11	8.16	7.50	12.27	9.00	4.48	3.00
1539	0.35	0.83	1.18	0.80	4.77	2.37	4.66	7.14	7.50	11.80	9.00	3.45	3.00
1540	0.41	1.02	1.43	0.80	5.45	2.19	3.60	7.64	7.50	11.24	9.00	3.09	3.00
1542	......	......	......	.....	7.94	3.10	2.23	11.04	10.50	13.27	12.00	1.95	2.00
1543	......	......	.....	......	7.43	3.64	2.07	11.07	10.50	13.14	12.00	1.80	2.00
1545	1.87	1.02	2.89	3.30	6.99	1.88	1.96	8.87	9.00	10.83	10.00	6.12	6.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
1546	E. Frank Coe's Red Brand Excelsior Guano
1548	E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate
1549	E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate
	F. J. CARSLEY, DEXTER, ME.
1555	Dexter Special Potato Manure
	HUBBARD FERTILIZER COMPANY, BALTIMORE, MD.
1559	Hubbard's Bone, Blood and Potash
1560	Hubbard's Farmers' I. X. L. Superphosphate
1561	Hubbard's Royal Ensign
	JOHN WATSON COMPANY, HOULTON, ME.
1565	Watson's Improved High Grade Potato Manure
	LISTERS AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
1568	Lister's Animal Bone and Potash
1569	Lister's Animal Bone and Potash
1570	Lister's High Grade Special for Spring Crops
1571	Lister's Oneida Special
1572	Lister's Oneida Special
1573	Lister's Potato Manure
1574	Lister's Potato Manure
1575	Lister's Pure Raw Bone Meal
1576	Lister's Special Corn Fertilizer
1577	Lister's Special Corn Fertilizer
1578	Lister's Special Potato Fertilizer
1579	Lister's Special Potato Fertilizer
1580	Lister's Success Fertilizer
1581	Lister's Success Fertilizer
1582	Lister's 10% Potato Grower
1583	Lister's 10% Potato Grower
	NATIONAL FERTILIZER COMPANY, BRIDGEPORT, CONN.
1586	Chittenden's Complete Root Fertilizer
1587	Chittenden's Eureka Potato Fertilizer
1588	Chittenden's Excelsior Potato Fertilizer
1589	Chittenden's Excelsior Potato Fertilizer
1590	Chittenden's Market Garden Fertilizer
	NEW ENGLAND EERTILIZER COMPANY, BOSTON, MASS.
1592	New England Complete Manure
1594	New England Corn and Grain Fertilizer
1595	New England Corn and Grain Fertilizer
1597	New Englaud Corn Phosphate
1598	New England Corn Phosphate
1600	New England High Grade Potato Fertilizer
1601	New England High Grade Potato Fertilizer
1603	New England High Grade Special 10 Per Cent Potash
1604	New England High Grade Special 10 Per Cent Potash
1605	New England Market Garden Manure
1607	New England Potato Fertilizer
1908	New England Potato Fertilizer
1609	New England Potato Grower
1610	New England Potato Grower
1612	New England Superphosphate
1613	New England Superphosphate

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1546	2.28	1.32	3.60	3.30	7.13	1.60	1.35	8.73	9.00	10.08	10.00	6.79	6.00
1548	0.44	0.92	1.36	1.20	6.71	2.16	1.42	8.87	8.50	10.29	10.00	2.14	2.00
1549	0.73	0.90	1.63	1.20	8.37	1.28	2.11	9.65	8.50	11.76	10.00	2.61	2.00
1555	2.39	1.08	3.47	3.70	5.81	1.54	2.19	7.35	7.00	9.54	8.00	9.87	10.00
1559	2.39	1.02	3.41	3.29	4.75	3.04	0.98	7.89	8.00	8.87	9.00	7.34	7.00
1560	0.95	1.22	2.17	1.65	3.19	4.88	1.79	8.07	8.00	9.86	9.00	2.18	2.00
1561	1.31	1.10	2.41	2.47	3.16	3.88	2.32	7.04	8.00	9.36	9.00	4.02	4.00
1565	1.96	1.21	3.17	3.00	3.81	3.43	2.81	7.24	6.00	10.05	7.00	5.24	5.00
1568	......	......	......	......	6.86	3.65	1.71	10.51	11.00	12.22	12.00	2.01	2.00
1569	......	......	......	......	4.08	6.41	2.51	10.49	11.00	13.00	12.00	2.11	2.00
1570	1.09	0.72	1.81	1.65	5.90	2.32	1.58	8.20	8.00	9.78	9.20	8.81	10.00
1571	0.73	0.67	1.40	0.82	3.54	4.21	2.46	7.75	7.00	10.21	8.00	1.32	1.00
1572	0.63	0.64	1.27	0.82	5.63	2.60	2.36	8.23	7.00	10.59	8.00	2.14	1.00
1573	1.65	1.50	3.15	3.30	4.94	3.29	2.39	8.23	8.00	10.62	9.00	6.14	7.00
1574	2.81	0.46	3.27	3.30	5.36	3.17	1.63	8.53	8.00	10.16	9.00	6.81	7.00
1575	0.71	1.94	2.65	2.68	......	......	......	......	.....	22.49	23.00	......	......
1576	1.25	0.86	2.11	1.65	4.61	3.34	2.54	7.95	8.00	10.49	9.00	3.19	3.00
1577	1.13	0.74	1.87	1.65	4.96	2.92	2.93	7.88	8.00	10.81	9.00	3.22	3.00
1578	1.13	0.74	1.87	1.65	5.39	2.45	2.78	7.84	8.00	10.62	9.00	3.06	3.00
1579	0.94	0.99	1.93	1.65	5.38	2.48	2.36	7.86	8.00	10.22	9.00	2.84	3.00
1580	0.92	0.38	1.30	1.25	6.28	3.09	3.13	9.37	9.00	12.50	11.00	2.72	2.00
1581	0.62	0.86	1.48	1.25	5.41	4.07	1.59	9.48	9.00	11.07	11.00	2.23	2.00
1582	1.83	1.30	3.13	3.30	4.16	3.05	1.37	7.21	6.00	8.58	......	10.14	10.00
1583	2.01	1.22	3.23	3.30	3.22	2.82	2.35	6.04	6.00	8.39	......	10.62	10.00
1586	1.60	1.54	3.14	3.30	6.30	1.82	1.80	8.12	8.00	9.92	10.00	7.67	6.00
1587	1.85	1.34	3.19	2.40	2.89	3.88	2.67	6.77	6.00	9.44	8.00	10.37	10.00
1588	2.31	1.16	3.47	3.30	2.41	3.25	3.56	5.66	6.00	9.22	8.00	11.19	10.00
1589	2.08	1.42	3.50	3.30	4.63	0.22	3.46	4.85	6.00	8.31	8.00	9.70	10.00
1590	1.66	0.64	2.30	2.40	3.54	3.08	2.42	6.62	6.00	9.04	8.00	5.11	5.00
1592	2.16	1.15	3.31	3.28	4.37	2.79	1.53	7.16	6.00	8.69	7.00	8.30	10.00
1594	0.57	0.70	1.27	1.22	4.94	2.13	2.37	7.07	7.00	9.44	.....	2.33	2.00
1595	0.63	0.68	1.31	1.22	5.02	2.32	1.22	7.34	7.00	8.56	......	2.01	2.00
1597	0.99	0.74	1.73	1.64	6.30	1.96	3.14	8.26	8.00	11.40	9.00	3.03	3.00
1598	1.00	0.78	1.78	1.64	6.64	1.80	2.55	8.44	8.00	10.99	9.00	3.17	3.00
1600	1.18	1.34	2.52	2.46	5.17	3.71	3.66	8.88	8.00	12.54	9.00	6.13	6.00
1601	1.20	1.10	2.30	2.46	4.66	3.28	2.32	7.94	8.00	10.26	9.00	6.76	6.00
1603	2.14	1.13	3.27	3.69	4.10	4.45	2.14	8.55	7.00	10.69	8.00	9.40	10.00
1604	1.79	1.70	3.49	3.69	5.87	1.97	2.27	7.84	7.00	10.11	8.00	10.16	10.00
1605	2.64	1.52	4.16	4.10	4.55	4.61	2.40	9.16	7.00	11.56	8.00	5.39	7.00
1607	1.14	0.82	1.96	1.64	5.63	2.64	1.54	8.27	7.00	9.81	8.00	4.14	4.00
1608	1.06	0.82	1.88	1.64	5.45	2.41	1.53	7.86	7.00	9.39	8.00	4.33	4.00
1609	1.10	1.24	2.34	2.46	4.83	2.11	2.02	6.94	6.00	8.96	7.00	9.69	10.00
1610	1.12	1.10	2.22	2.46	3.37	4.06	2.09	7.43	6.00	9.52	7.00	9.80	10.00
1612	1.22	1.25	2.47	2.46	6.27	3.22	2.90	9.49	9.00	12.39	10.00	4.00	4.00
1613	1.27	1.10	2.37	2.46	6.86	3.39	2.96	10.25	9.00	13.21	10.00	3.87	4.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
	OLDS & WHIPPLE, HARTFORD, CONN.
1617	Excelsior Potato Fertilizer
	PARMENTER & POLSLEY FERTILIZER COMPANY, PEABODY, MASS.
1620	A. A. Brand
1621	Aroostook Special
1622	Aroostook Special
1623	Fine Ground Bone
1624	Muriate of Potash
1625	Nitrate of Soda
1626	P. P. Grain Grower
1627	P. P. Potato Fertilizer
1628	Plymouth Rock Brand Fertilizer
1629	Special Potato Fertilizer
1630	Star Brand Superphosphate
	PORTLAND RENDERING COMPANY, PORTLAND, ME.
1635	Bone Dust Tankage
1636	Bone Dust Tankage
	R. T. PRENTISS COMPANY, PRESQUE ISLE, ME.
1640	Prentiss Aroostook Complete Fertilizer
1641	Prentiss Aroostook Complete Fertilizer
1642	Prentiss Aroostook Special
1643	Prentiss Aroostook Standard
1644	Tuscarora Fruit and Potato Fertilizer
1645	Tuscarora Fruit and Potato Fertilizer
	PROVINCIAL CHEMICAL FERTILIZER COMPANY, ST. JOHN, N. B.
1647	Special Potato Phosphate
1648	Ten Per Cent Aroostook Complete Potato
	P. H. READ, FORT FAIRFIELD, ME.
1649	Read's Potato Grower
	RUSSIA CEMENT COMPANY, GLOUCESTER, MASS.
1652	Essex A1 Superphosphate
1653	Essex Complete Manure for Aroostook County Crops
1654	Essex Market Garden and Potato Manure
1655	Essex XXX Fish and Potash
1656	Essex XXX Fish and Potash
	SAGADAHOC FERTILIZER COMPANY, BOWDOINHAM, ME.
1661	Acid Phosphate
1662	Aroostook Potato Manure
1663	Aroostook Potato Manure
1664	Dirigo Grass and Grain Fertilizer
1666	Muriate of Potash
1667	Nitrate of Soda
1668	Sagadahoc High Grade Superphosphate
1669	Sagadahoc Special Potato Fertilizer
1670	Sagadahoc Special Potato Fertilizer
1671	XX Chemical Fertilizer
1672	Yankee Fertilizer
1673	Yankee Fertilizer
1674	3-6-10 Fertilizer
	J. W. SANBORN, GILMANTON, N. H.
1676	Sanborn's Special Potato Fertilizer
	SCIENTIFIC FERTILIZER COMPANY, BUFFALO, N. Y.
1678	Scientific Potato and Vegetable Fertilizer

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1617	1.23	2.18	3.41	3.30	0.51	5.86	1.30	6.37	6.00	7.67	......	9.73	10.00
1620	2.37	1.61	3.98	4.10	3.72	4.51	3.06	8.23	7.00	11.29	8.00	8.24	8.00
1621	1.69	1.78	3.47	3.29	4.91	2.95	2.28	7.86	7.00	10.14	8.00	9.87	10.00
1622	2.01	1.58	3.59	3.29	4.37	4.29	2.70	8.66	7.00	11.36	8.00	9.48	10.00
1623	1.00	1.48	2.48	2.44	......	......	......	......	5.00	25.76	23.00	......	......
1624	......	......	......	......	......	......	......	......	......	......	......	46.52	50.00
1625	15.41	......	15.41	14.81	......	......	......	......	......	......	......	......	......
1626	0.51	0.50	1.01	0.82	5.38	2.10	1.53	7.48	7.00	9.01	8.00	2.30	2.00
1627	0.52	1.14	1.66	1.64	3.32	3.51	1.86	6.83	6.00	8.69	7.00	4.90	6.00
1628	1.19	1.18	2.37	2.47	5.33	3.36	2.17	8.69	8.00	10.86	9.00	4.08	4.00
1629	1.89	1.18	3.07	3.29	5.30	3.73	2.17	9.03	8.00	11.20	9.00	7.34	7.00
1630	0.68	0.84	1.52	1.64	4.23	3.30	2.25	7.53	7.00	9.78	8.00	2.62	2.50
1635	0.62	4.20	4.82	5.50	......	......	......	......	......	17.26	16.00	......	......
1636	0.50	4.46	4.96	5.50	......	......	......	......	......	16.72	16.00	......	......
1640	2.31	0.92	3.23	3.29	3.78	3.09	1.74	6.87	6.00	8.61	8.00	10.07	10.00
1641	2.26	0.92	3.18	3.29	3.46	3.23	1.43	6.69	6.00	8.12	8.00	9.87	10.00
1642	1.49	1.18	2.67	2.88	6.86	1.93	0.19	8.79	7.00	8.98	8.00	8.44	8.00
1643	1.15	1.04	2.19	2.47	7.37	1.75	0.15	9.12	6.00	9.27	8.00	5.11	5.00
1644	1.05	0.58	1.63	1.65	6.06	2.72	0.92	8.78	8.00	9.70	10.00	8.63	10.00
1645	1.07	0.48	1.55	1.65	5.73	2.42	0.54	8.15	8.00	8.69	10.00	10.01	10.00
1647	1.25	1.14	2.39	2.00	4.80	2.48	7.62	7.28	8 00	14.90	......	6.25	6.00
1648	2.18	0.92	3.10	3.29	4.90	2.37	3.99	7.27	8.00	11.26	......	9 62	10.00
1649	1.76	1.59	3.35	3.30	1.55	4.28	3.28	5.83	6.00	9.11	7.00	6.77	8.00
1652	0.10	1.06	1.16	1.00	0.93	5.13	4.95	6.06	7.00	11.01	9.00	2.19	2.00
1653	1.19	2.18	3.37	3.30	5.42	3.92	1.84	9.34	7.00	11.18	9.00	9.58	9.50
1654	0.97	0.92	1.89	2.00	0.83	6.59	4.80	7.42	8.00	12.22	10.00	5.95	5.00
1655	0.44	1.58	2.02	2.10	1.18	5.67	6.55	6.85	9.00	13.40	12.00	2.70	2.25
1656	0.95	1.60	2.55	2.10	0.72	6.07	6.48	6.79	9.00	13.27	12.00	2.44	2.25
1661	......	......	......	......	13.91	3.25	0.45	17.16	16.00	17.61	17.00	......	......
1662	0.74	0.46	1.20	1.05	4.40	3.48	1.08	7.88	6.00	8.96	7.00	2.75	4.00
1663	1.17	0.22	1.39	1.05	2.74	3.30	0.96	6.04	6.00	7.00	7.00	4.03	4.00
1664	0.31	0.56	0.87	0.85	2.09	4.87	1.56	6.96	6.00	8.52	9.00	5.18	3.00
1666	......	......	......	......	......	......	......	......	......	......	......	49.08	50.00
1667	15.61	......	15.61	15.00	......	......	......	......	......	......	......	......	......
1668	1.16	0.46	1.62	1.85	5.30	3.64	0.96	8.94	7.00	9.90	8.00	3.52	3.00
1669	1.15	0.54	1.69	2.00	5.44	3.98	0.76	9.42	7.00	10.18	8.00	7.30	8.00
1670	1.32	0.66	1.98	2.00	3.43	5.00	0.98	8.43	7.00	9.41	8.00	7.74	8.00
1671	6.84	1.18	8.02	7.00	0.10	7.69	0.46	7.79	3.00	8.25	7.00	8.07	8.00
1672	0.72	0.06	0.78	0.40	6.86	2.17	0.08	9.03	7.00	9.11	8.00	2.23	2.00
1673	0.61	0.10	0.71	0.40	6.17	3.54	0.61	9.71	7.00	10.32	8.00	2.51	2.00
1674	1.43	0.68	2.11	2.20	4.47	3.91	0.54	8.38	6.00	8.92	7.00	9.34	10.00
1676	1.88	1.31	3.19	3.30	2.93	6.26	1.72	9.19	6.50	10.91	9.50	10.51	10.00
1678	2.97	0.90	3.87	3.33	2.71	4.51	2.25	7.22	7.00	9.47	8.00	7.43	10.00

Descriptive List of Station Samples, 1906.

Station number.	Manufacturer, place of business and brand.
	SWIFT'S LOWELL FERTILIZER COMPANY, BOSTON, MASS.
1685	Acid Phosphate
1686	Ground Bone
1687	Muriate of Potash
1688	Nitrate of Soda
1689	Swift's Lowell Animal Brand
1690	Swift's Lowell Animal Brand
1693	Swift's Lowell Bone Fertilizer
1694	Swift's Lowell Bone Fertilizer
1695	Swift's Lowell Cereal Fertilizer
1696	Swift's Lowell Cereal Fertilizer
1698	Swift's Lowell Dissolved Bone and Potash
1699	Swift's Lowell Dissolved Bone and Potash
1701	Swift's Lowell Empress Brand
1702	Swift's Lowell Empress Brand
1703	Swift's Lowell Potato Grower
1705	Swift's Lowell Potato Manure
1706	Swift's Lowell Potato Manure
1708	Swift's Lowell Potato Phosphate
1709	Swift's Lowell Potato Phosphate
1711	Swift's Lowell Superior Fertilizer with 10% Potash
1712	Swift's Lowell Superior Fertilizer with 10% Potash
	WHITMAN & PRATT RENDERING COMPANY, LOWELL, MASS.
1715	Potash Special
1716	Vegetable Grower

Analyses of Station Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
1685	......	......	......	......	1.23	9.94	3.70	11.17	12.00	14.87	14.00	......	......
1686	0.74	2.58	3.32	2.47	......	......	......	......	......	24.71	23.00	......	......
1687	......	......	......	......	......	......	......	......	......	......	......	45.08	50.00
1688	15.25	......	15.25	15.00	......	......	......	......	......	......	......	......	......
1689	1.21	1.10	2.31	2.40	6.79	3.92	2.58	10.71	9.00	13.29	10.00	4.25	4.00
1690	1.32	1.11	2.43	2.46	6.64	3.98	2.67	10.62	9.00	13.29	10.00	4.19	4.00
1693	1.01	0.72	1.73	1.64	6.78	2.52	1.91	9.30	8.00	11.21	9.00	3.24	3.00
1694	1.11	0.73	1.84	1.64	6.65	2.53	2.08	9.18	8.00	11.26	9.00	3.21	3.00
1695	0.40	0.49	0.89	0.82	4.63	2.71	1.19	7.34	7.00	8.53	8.00	1.23	1.00
1696	0.31	0.53	0.84	0.82	4.77	2.31	1.10	7.08	7.00	8.18	8.00	1.16	1.00
1698	0.77	0.84	1.61	1.64	5.71	4.22	2.99	9.93	9.00	12.92	10.00	2.21	2.00
1699	0.64	0.98	1.62	1.64	7.40	3.51	1.96	10.91	9.00	12.87	10.00	2.00	2.00
1701	0.64	0.70	1.34	1.23	5.23	2.45	1.59	7.68	7.00	9.27	8.00	2.18	2.00
1702	0.68	0.62	1.30	1.23	4.90	2.41	1.16	7.31	7.00	8.47	8.00	2.13	2.00
1703	2.19	0.92	3.11	3.28	3.91	3.38	1.29	7.29	6.00	8.58	7.00	10.55	10.00
1705	1.01	0.75	1.76	1.64	5.47	2.88	1.43	8.35	7.00	9.78	8.00	5.11	4.00
1706	0.87	0.81	1.68	1.64	5.47	3.41	1.65	8.88	7.00	10.53	8.00	4.20	4.00
1708	1.38	1.05	2.43	2.46	5.14	2.68	1.49	7.82	8.00	10.37	9.00	6.00	6.00
1709	1.36	1.02	2.38	2.46	5.61	2.96	1.56	8.57	8.00	10.13	9.00	6.27	6.00
1711	2.03	1.41	3.44	3.69	3.72	5.16	1.85	8.88	7.00	10.73	8.00	9.92	10.09
1712	1.95	1.22	3.17	3.69	4.21	4.61	1.59	8.82	7.00	10.41	8.00	10.17	10.09
1715	0.74	1.64	2.38	2.89	2.07	7.16	2.09	9.23	6.00	11.32	8.00	10.49	10.00
1716	2.52	1.01	3.53	3.29	1.60	7.61	1.19	9.21	8.00	10.40	10.00	6.56	7.00

Descriptive List of Manufacturer's Samples Licensed After March 1, 1906.

Station number.	Manufacturer, place of business and brand.
	BOWKER FERTILIZER COMPANY, BOSTON, MASS.
1118	Special Potato Manure for the Grange..........
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
1143	Bone Meal..........
	SAGADAHOC FERTILIZER COMPANY, BOWDOINHAM, ME.
1200	3-6-10 Fertilizer..........
	R. T. PRENTISS COMPANY, PRESQUE ISLE, ME.
1214	Tuscorora Fruit and Potato..........
	WHITMAN & PRATT RENDERING COMPANY, LOWELL, MASS.
1216	Ammoniated Superphosphate..........
1217	Potato Manure..........
	ARMOUR FERTILIZER WORKS, BALTIMORE, MD.
1218	Fruit and Root Crop Special..........
	J. W. SANBORN, GILMANTON, N. H.
1219	Sanborn's Chemical Fertilizer for Potatoes..........
	SWIFT'S LOWELL FERTILIZER COMPANY, BOSTON, MASS.
1220	Swift's Potato Grower..........
1221	Swift's Special Bone and Potash..........

Analyses of Manufacturers Samples, 1906.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total. Found.	Total. Guaranteed.	Soluble.	Reverted.	Insoluble.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Found.	Guaranteed.
%	%	%	%	%	%	%	%	%	%	%	%	%	%
1118	0.79	1.52	2.30	1.50	4.04	5.69	1.71	9.73	9.00	11.44	12.00	11.40	12.00
1143	0.58	3.12	3.70	2.68	......	......	......	......	......	25.33	23.00	......	......
1200	1.63	0.56	2.19	2.20	3.51	5.12	1.08	8.63	6.00	9.71	7.00	9.27	10.00
1214	0.52	1.26	1.78	1.65	5.77	3.06	0.79	8.83	8.00	9.62	10.00	10.31	10.00
1216	0.33	0.80	1.13	0.82	5.28	4.72	1.61	10.00	8.00	11.61	10.00	2.41	3.00
1217	1.34	1.01	2.35	2.47	2.44	4.81	1.28	7.25	7.00	8.53	9.00	5.41	5.00
1218	1.02	0.78	1.80	1.65	4.85	3.70	1.01	8.55	8.00	9.56	10.00	5.69	5.00
1219	1.72	1.65	3.37	3.30	3.49	5.91	1.11	9.40	6.50	10.51	9.50	11.00	10.00
1220	1.16	2.10	3.26	3.28	2.73	6.56	0.89	9.29	6.00	10.18	7.00	10.40	10.00
1221	......	......	......	......	6.59	3.21	1.33	9.80	10.00	11.13	31.00	2.76	2.00

[Continued from page 177.]

So far as different lots were found by the inspector two analyses of the same brand are given in the tables. A few brands that were licensed were not actually shipped into the State and in two or three instances the inspector failed to find the brands in the hands of the dealers or agents.

During the years immediately following 1895 there was a tendency to the multiplication of brands. At present it is only rarely that a company that has been doing business in the State for years offers a new brand. With the growth of the sale of fertilizers in the State, companies that formerly did no business in Maine are now sending their goods to the State. This of course results in an increase in the number of brands. While it is unfortunate that so many farmers buy fertilizers from a name rather than from the amount of plant food contained in the fertilizer, it is gratifying that brands are not being unnecessarily multiplied. There has been a constant increase from the 20 brands licensed in 1885 to 200 or more brands of complete manures and single ingredient chemicals licensed in 1906.

When the manufacturers first put their goods upon the market, recognizing the difficulty of accurate mixing, they placed a somewhat elastic guarantee upon them. For instance, potash might be guaranteed 4 to 5 per cent and for the most part the goods would carry 4.5 per cent of potash. As competition became closer and the process of manufacture became somewhat more trustworthy, the manufacturers worked closer and closer to the minimum guarantee so that at present it rarely happens that high grade fertilizers carry much above the minimum percentages of nitrogen and potash, the more costly constituents of a fertilizer. If this were the whole story there would be nothing to complain of, but up to the present year there has been an increasing tendency to fail to maintain the goods up to their minimum guarantee.

For the most part these are slight and generally in only one constituent. It also frequently happens that the other constituents are in sufficient excess to preclude any idea of intention on the part of the manufacturer not to live up to the guarantee. Usually the trouble is due to incomplete mixing. For instance in some formulas not more than 100 pounds of nitrate of soda are used per ton. Nitrate of soda is a crystalline material and

it is difficulty to so completely powder it and thoroughly incorporate it in the goods that the sample drawn in the inspector's tube shall have its just amount—neither too much nor yet too little. To try to meet this difficulty, the samples are taken from a large number of packages and the final sub-sample is taken with the greatest care. It is because of the difficulty of accurate sampling of fertilizers that the Station only undertakes the analysis of samples taken by its inspector, and employs an experienced chemist who from his laboratory experience fully recognizes the importance and difficulties of correct sampling.

It is only fair to the manufacturers to say that probably no class of goods are more nearly sold on their merits than are commercial fertilizers. So far as the writer knows, there has not been a case in 10 years that could be called a wilful attempt on the part of a maker of fertilizers sold in Maine to defraud.

THE COMPARISON OF STATION ANALYSES FOR THREE YEARS.

It is important that the purchaser of fertilizers should know the analyses not merely for the current year but as a guide for future purchase to know how they have run for several years. The tables on pages 178 and following of this bulletin, show how the samples collected by the Station inspector in 1906 compare with the guarantees. The tables beginning on page 197 give the analyses, so far as total nitrogen, available phosphoric acid and potash are concerned, for the years 1904, 1905, and 1906. When the gurantees have been changed from that of previous years, the fact is indicated by a foot note.

In studying the table of comparisons of the analyses of Station samples for three years, it will be found that many goods run quite uniform year after year. This is particularly true as regards phosphoric acid, and this is readily understood when it is remembered that the superphosphate is the starting point and that the materials furnishing nitrogen and potash are usually added to this. The potash and nitrogen are the more expensive substances in fertilizers and the more difficult to mix and hence greater variation is found in these constituents.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
A. A. C. Co. Aroostook Complete Manure	1906	2.56	7.17	10.21
A. A. C. Co. Aroostook High Grade	1906	4.35	8.15	6.31
Bradley's Alkaline Bone with Potash	1904	....	9.85	2.16
	1905	....	10.69	1.95
	1906	....	11.19	2.10
Bradley's Comp. Manure for potatoes and vegetables.	1904	3.06	7.97	6.70
	1905	3.05	7.79	6.92
	1906	3.27	8.69	6.79
Bradley's Complete Manure with 10% Potash	1904	3.27	6.60	11.02
	1905	3.32	5.56	9.66
	1906	3.36	7.03	9.79
Bradley's Corn Phosphate	1904	2.14	8.93	1.80
	1905	2.11	8.05	1.87
	1906	2.18	8.51	2.06
Bradley's Eureka Fertilizer	1904	1.14	8.34	2.23
	1905	1.10	8.42	2.36
	1906	1.19	8.55	2.14
Bradley's Niagara Phosphate	1904	1.18	8.34	2.18
	1905	1.10	6.50	1.27
	1906	1.19	9.14	1.97
Bradley's Potato Fertilizer	1904	2.22	7.93	3.66
	1905	1.96	7.74	3.41
	1906	2.10	9.46	3.04
Bradley's Potato Manure	1904	2.60	7.14	5.93
	1905	2.56	6.84	5.26
	1906	2.60	6.76	5.01
Bradley's X. L. Superphosphate of Lime	1904	2.25	9.17	2.23
	1905	2.33	8.69	2.22
	1906	2.55	9.26	2.40
Clark's Cove Bay State Fertilizer	1904	2.48	8.73	2.42
	1905	2.32	9.39	2.33
	1906	2.58	8.95	2.57
Clark's Cove Bay State Fertilizer G. G	1904	2.32	8.06	1.71
	1905	1.94	8.19	1.92
	1906	2.09	7.94	1.95
Clark's Cove Bay State Fertilizer for Seeding Down..	1904	1.17	8.74	2.19
	1905	1.06	8.14	1.80
	1906	1.13	8.42	2.04
Clark's Cove Defiance Complete Manure	1904	0.82	7.93	1.40
	1905	1.06	6.29	1.43
	1906	1.39	8.04	2.29
Clark's Cove Great Planet Manure A. A	1904	3.38	7.89	7.36
	1905	3.24	7.05	6.64
	1906	3.39	8.01	7.60
Clark's Cove King Phillip Alkaline Guano	1904	1.11	8.30	2.13
	1905	1.09	7.89	1.78
	1906	1.10	8.48	2.09

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct	Per ct.
Clark's Cove Potato Fertilizer	1904 1905 1906	1.94 2.03 2.05	8.08 8.13 8.26	3.17 2.99 3.36
Clark's Cove Potato Manure	1904 1905 1906	2.56 2.58 2.61	6.92 6.27 7.07	5.62 5.62 5.48
Cleveland Fertilizer for all Crops	1904 1905 1906	1.08 1.00 1.38	7.96 9.76 8.21	2.09 2.18 2.43
Cleveland High Grade Complete Manure	1904 1905 1906	3.37 3.07 2.95	7.58 6.54 8.16	7.65 6.62 7.91
Cleveland Potato Phosphate	1904 1905 1906	2.10 2.01 2.14	8.47 8.75 8.08	3.02 3.02 3.13
Cleveland Seeding Down Fertilizer	1904 1906	1.04 1.11	9.02 8.31	2.04 2.10
Cleveland Superphosphate	1904 1905 1906	2.08 1.71 2.14	7.98 8.13 7.57	1.81 1.68 1.84
Complete Manure with 10% Potash	1904 1905 1906	3.12 3.26 3.17	5.64 5.70 6.42	9.74 10.79 9.85
Crocker's Ammoniated Corn Phosphate	1904 1905 1906	2.14 1.85 2.19	8.33 7.40 8.03	1.82 1.75 1.87
Crocker's Aroostook Potato Special	1904 1905 1906	1.99 2.01 2.00	8.61 7.45 8.69	6.26 5.95 5.90
Crocker's Grass and Oats Fertilizer	1904 1905 1906	....	9.87 9.89 10.58	2.19 2.10 2.14
Crocker's High Grade	1906	3.23	8.15	6.58
Crocker's New Rival Ammoniated Superphosphate	1904 1905 1906	1.14 1.13 1.31	7.90 7.97 8.28	2.03 1.98 2.30
Crocker's Potato, Hop and Tobacco	1904 1905 1906	1.92 2.04 2.04	7.54 8.07 7.99	3.19 2.97 3.10
Crocker's Special Potato Manure	1904 1905 1906	2.78 3.32 3.33	6.98 7.03 6.73	10.28 8.44 10.91
Cumberland Guano for all Crops	1904 1905 1906	1.14 1.40 1.04	8.00 7.90 8.79	2.15 2.05 2.29

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Cumberland Potato Fertilizer	1904	2.40	9.44	3.09
	1905	2.05	8.01	3.11
	1906	2.21	8.51	3.34
Cumberland Seeding Down Manure	1904	1.26	8.65	2.09
	1905	1.16	8.05	2.16
	1906	1.14	9.09	2.24
Cumberland Superphosphate	1904	2.18	8.54	1.71
	1905	1.91	7.31	*1.54
	1906	2.12	7.87	2.43
Darling's Blood, Bone and Potash	1904	3.83	7.21	7.53
	1905	3.77	5.95	6.70
	1906	4.32	6.69	8.09
Grass and Lawn Top Dressing	1905	4.80	4.86	3.32
	1906	4.93	5.84	2.62
Great Eastern General Fertilizer	1904	1.02	8.04	4.28
	1905	0.81	6.26	3.93
	1906	0.99	7.55	3.87
Great Eastern Grass and Oats Fertilizer	1904	....	9.96	2.29
	1905	....	10.06	2.19
	1906	....	10.61	2.06
Great Eastern High Grade Potato Manure	1904	3.42	6.23	11.17
	1905	3.21	6.43	9.72
	1906	3.48	7.38	10.13
Great Eastern Northern Corn Special	1904	2.30	8.06	1.82
	1905	2.05	7.67	1.81
	1906	2.39	8.80	2.06
Great Eastern Potato Manure	1904	1.85	8.64	3.30
	1905	2.10	7.60	3.18
	1906	2.10	8.30	3.32
Great Eastern Potato Special	1906	3.35	8.45	7.32
High Grade Fertilizer with 10% Potash	1904	2.46	7.22	10.18
	1905	2.48	5.63	9.68
	1906	2.61	6.48	10.26
Lazaretto Aroostook Potato Guano	1904	1.16	7.63	3.76
	1905	0.84	7.03	4.11
	1906	0.98	8.30	4.06
Lazaretto Corn Guano	1904	1.84	7.63	2.11
	1905	2.28	*7.48	2.37
	1906	2.16	7.42	2.37
Lazaretto High Grade Potato Manure	1904	3.24	5.41	10.83
	1905	3.02	5.00	10.13
	1906	3.38	6.10	10.58

*Guarantee changed in 1905. †Guarantee changed in 1906.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total Nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Lazaretto Propeller Potato Guano	1904	1.96	8.31	5.88
	1905	1.73	8.32	5.81
	1905	2.05	8.16	5.62
Otis' Potato Fertilizer	1904	2.14	7.60	3.03
	1905	2.07	7.20	3.05
	1906	2.03	8.46	3.11
Otis' Seeding Down Fertilizer	1904	1.14	8.23	2.06
	1905	1.10	7.46	2.14
	1906	1.17	8.54	2.22
Otis' Superphosphate	1904	2.20	9.95	1.72
	1905	2.06	7.42	1.78
	1906	2.23	9.19	1.96
Pacific Dissolved Bone and Potash	1904	....	9.46	2.17
	1905	....	8.93	2.00
	1906	....	10.29	2.08
Pacific Grass and Grain Fertilizer	1904	0.94	6.94	1.17
	1905	0.82	7.94	1.22
	1906	1.16	8.96	1.51
Pacific High Grade General Fertilizer	1904	3.84	7.98	6.49
	1905	3.09	7.23	7.33
	1906	3.17	8.34	7.07
Pacific Nobsque Guano	1904	1.24	9.90	2.14
	1905	1.10	.7.49	1.96
	1906	1.12	8.50	2.29
Pacific Potato Special	1904	2.01	8.56	3.28
	1905	1.95	7.72	3.19
	1906	2.07	7.55	3.42
Packer's Union Animal Corn Fertilizer	1904	2.56	10.05	2.23
	1905	2.36	8.94	2.35
	1906	2.50	9.26	2.38
Packer's Union Economical Vegetable Guano	1904	1.26	7.32	3.71
	1905	1.26	6.09	3.80
	1906	1.37	6.66	4.49
Packer's Union Gardeners Complete Manure	1904	2.22	6.40	10.35
	1905	2.25	5.48	8.65
	1906	2.47	6.67	10.26
Packer's Union High Grade	1906	3.25	8.48	7.27
Packer's Union Potato Manure	1904	2.00	8.75	6.07
	1905	1.92	8.21	5.44
	1906	2.21	9.12	6.40
Packer's Union Universal Fertilizer	1904	1.06	8.15	3.80
	1905	0.69	6.68	4.07
	1906	1.24	8.25	4.18

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total Nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Packer's Union Wheat, Oats and Clover Fertilizer	1906	....	11.16	2.45
Quinnipiac Climax Phosphate for all Crops	1904	1.43	8.34	2.78
	1905	1.13	7.16	1.94
	1906	1.18	8.60	2.05
Quinnipiac Corn Manure	1904	2.34	9.89	1.78
	1905	1.86	8.05	1.71
	1906	2.13	8.63	2.23
Quinnipiac Market Garden Manure	1904	3.07	7.66	6.48
	1905	3.17	9.18	6.48
	1906	3.33	8.16	7.28
Quinnipiac Mohawk Fertilizer	1904	0.88	7.11	1.13
	1905	0.88	6.80	1.29
	1906	1.22	8.39	2.29
Quinnipiac Potato Manure	1904	2.38	6.98	5.24
	1905	2.56	6.13	5.25
	1906	2.59	7.54	5.05
Quinnipiac Potato Phosphate	1904	2.06	7.98	2.82
	1905	2.09	7.58	2.80
	1906	2.08	8.84	3.35
Read's Farmers' Friend Superphosphate	1904	2.29	8.05	3.00
	1905	2.10	8.05	3.03
	1906	2.03	8.42	3.76
Read's High Grade Farmer's Friend	1904	3.12	5.64	9.74
	1905	3.32	5.08	11.68
	1906	3.31	6.55	7.38
Read's Potato Manure	1904	3.62	7.07	11.36
	1905	2.42	5.38	9.48
	1906	2.59	6.10	9.76
Read's Practical Potato Special	1904	0.98	4.95	10.04
	1905	1.52	4.21	8.01
	1906	1.05	5.87	6.65
Read's Standard Superphosphate	1904	1.24	8.26	4.26
	1905	1.06	7.14	4.03
	1906	1.00	7.92	3.95
Read's Sure Catch Fertilizer	1904	....	10.50	2.21
	1905	....	10.46	2.08
	1906	....	9.69	2.06
Read's Vegetable and Vine Fertilizer	1904	1.94	8.22	6.45
	1905	1.86	7.37	6.06
	1906	2.12	8.34	5.16
Soluble Pacific Guano	1904	2.16	7.86	1.80
	1905	2.26	8.17	1.51
	1906	2.10	8.25	1.99

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Standard A. Brand	1904	1.14	8.00	2.20
	1905	1.40	6.34	2.20
	1006	1.19	8.03	1.67
Standard Bone and Potash	1904	....	9.79	2.20
	1905	....	8.83	2.07
	1906	....	10.79	2.03
Standard Complete Manure	1904	2.23	8.64	7.27
	1905	3.20	7.90	6.45
	1906	3.38	8.19	7.38
Standard Fertillzer	1904	2.14	8.44	1.86
	1905	1.87	8.07	1.73
	1906	2.24	7.97	1.86
Standard Guano for all Crops	1904	1.12	8.83	2.18
	1905	1.11	7.94	1.90
	1606	1.22	8.18	2.14
Standard Special for Potatoes	1904	2.30	9.01	3.16
	1905	1.99	7.84	2.94
	1906	2.14	8.22	3.07
Williams & Clark's Americus Ammoniated Bone Superphosphate	1905	2.37	8.86	1.97
	1906	2.43	9.29	2.25
Williams & Clark's Americus Corn Phosphate	1904	2.15	8.45	1.67
	1905	1.89	8.67	1.60
	1906	2.18	8.14	1.97
Williams & Clark's Americus High Grade Special	1904	2.86	7.44	6.40
	1905	3.06	6.80	6.87
	1906	3.30	8.55	7.15
Williams & Clark's Americus Potato Manure	1904	2.14	8.27	3.25
	1905	1.99	7.71	2.93
	1906	2.05	8.11	3.24
Williams & Clark's Royal Bone Phosphate for all Crops	1904	1.20	7.94	2.41
	1905	1.16	7.88	2.34
	1906	1.16	7.93	2.18
Armour's All Soluble	1906	2.71	9.44	4.02
Armour's Bone, Blood and Potash	1906	3.90	7.94	8.39
Armour's Fruit and Root Crop Special	1906	1.86	8.34	5.77
Armour's Grain Grower	1906	1.67	8.46	2.05
Armour's High Grade Potato Fertilizer	1906	1.61	8.42	9.86
Armour's Wheat, Corn and Oats Special Fertilizer	1906	0.92	8.10	1.03
Bowker's Bone, Blood and Potash	1904	4.16	8.86	7.07
	1905	3.88	6.10	6.37
	1906	4.02	7.60	7.01
Bowker's Bone and Potash Square Brand	1904	1.88	9.44	2.09
	1905	1.78	7.26	*2.01
	1906	2.04	7.85	2.29

* Guarantee changed in 1905.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Bowker's Corn Phosphate	1904	1.94	7.67	2.03
	1905	1.86	7.66	2.37
	1906	2.01	7.78	2.45
Bowker's Early Potato Manure	1904	3.26	7.29	6.82
	1905	3.01	7.85	6.65
	1906	3.36	7.66	7.56
Bowker's Farm and Garden Phosphate	1904	1.78	7.53	2.19
	1905	1.85	7.61	2.26
	1906	1.88	8.04	2.27
Bowker's Hill and Drill Phosphate	1904	2.25	9.05	2.18
	1905	2.43	8.86	2.23
	1906	2.44	9.28	2.33
Bowker's Market Garden Fertilizer	1904	2.20	7.13	10 39
	1905	2.27	5.71	9.32
	1906	2.77	6.61	9.90
Bowker's Potash Bone	1904	1.00	7.42	2.08
	1905	1.02	8.17	1.72
	1906	1.16	8.81	2.11
Bowker's Potash or Staple Phosphate	1904	0.83	7.78	2.85
	1905	1.04	8.21	2.88
	1906	1.19	8.28	3.34
Bowker's Potato and Vegetable Fertilizer	1904	2.47	8.49	4.22
	1905	2.17	8.14	4.60
	1906	2.58	8.76	4.35
Bowker's Potato and Vegetable Phosphate	1904	1.55	7.91	2.03
	1905	1.89	7.96	2.14
	1906	1.71	8.77	2.16
Bowker's Six Per Cent Potato Fertilizer	1904	1.08	7.47	6.48
	1905	0.82	6.27	5.67
	1906	1.29	7.62	6.34
Bowker's Superphosphate of Potash for Grass and Grain	1904	....	9.73	2.25
	1905	....	10.35	1.80
	1906	....	10.40	1.89
Bowker's Sure Crop Phosphate	1904	1.14	10.15	2.07
	1905	1.17	7.80	1.86
	1906	1.34	8.57	2.15
Bowker's Ten Per Cent Manure	1904	0.71	6.53	9.50
	1905	0.82	5.53	10.75
	1906	1.03	6.95	7.80
Monticello Grange Chemicals	1904	2.58	8.52	4.29
	1905	2.34	8.16	4.32
	1906	2.52	8.22	4.01
Special Potato Manure for the Grange	1904	1.34	10.17	13.35
	1905	1.44	9.08	11.02
	1906	1.79	9.06	12.06

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Stockbridge's Special Manure for Corn (Class D 107)	1904	3.24	7.58	7.03
	1905	2.96	10.54	6.36
	1906	3.55	9.02	†6.12
Stockbridge's Special Manure for the Grass (Class F 56)	1906	4.91	6.02	6.20
Stockbridge's Special Manure for Potatoes (Class D 610)	1904	3.16	6.09	9.58
	1905	3.20	5.03	10.10
	1906	3 11	6.15	9.74
Stockbridge's Special Manure for Seeding Down (Class C 610)	1904	2.38	7.06	10.62
	1905	3.10	7.76	10.11
	1906	2.45	7.01	10.40
E. Frank Coe's Celebrated Special Potato Fertilizer	1904	1.76	10.00	4.92
	1905	2.04	7.32	4.11
	1906	1.72	8.22	3.92
E. Frank Coe's Columbian Corn Fertilizer	1904	1.40	9.74	2.70
	1905	1.64	7.30	2.93
	1906	1.57	8.16	2.78
E. Frank Coe's Columbian Potato Fertilizer	1904	1.36	9.88	2.56
	1905	1.80	8.62	2.70
	1906	1.42	8.68	2.73
E. Frank Coe's Excelsior Potato Fertilizer	1904	2.15	8.16	7.43
	1905	*2.68	6.84	8.53
	1906	2.59	7.30	8.38
E. Frank Coe's Grass and Grain Special Fertilizer	1904	1.77	8.79	2.61
	1905	1.08	8.99	1.80
	1906	1.09	9.01	1.66
E. Frank Coe's High Grade Ammoniated Bone Superphosphate	1904	2.40	10.58	2.57
	1905	2.42	8.52	2.59
	1906	2.18	9.11	2.77
E. Frank Coe's High Grade Potato Fertilizer	1904	2.78	8.37	6.18
	1905	2.70	*8.05	6.02
	1906	2.61	8.34	5.68
E. Frank Coe's New Englander Corn Fertilizer	1904	1.04	9.18	3.21
	1905	1.48	8.07	3.17
	1906	1.49	8.27	4.02
E. Frank Coe's New Englander Potato Fertilizer	1904	1.04	9.02	3.10
	1905	1.52	6.96	3.24
	1906	1.30	7.39	3.27
E. Frank Coe's Prize Brand Grain and Grass	1904	....	10.01	3.31
	1905	....	8.11	2.01
	1906	....	11.05	1.87
E. Frank Coe's Red Brand Excelsior Guano	1904	3.32	10.68	6.11
	1905	*3.13	8.40	5.94
	1906	3.24	8.80	6.45
E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate	1904	1.30	9.96	2.26
	1905	1.82	8.39	2.22
	1906	1.49	9.26	2.37

* Guarantee changed in 1905. † Guarantee changed in 1906.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Dexter Special Potato Manure	1906	3.47	7.35	9.87
Hubbard's Bone, Blood and Potash	1905	2.91	7.97	7.51
	1906	3.41	7.89	7.34
Hubbard's Farmers' I. X. L. Superphosphate	1905	1.76	7.52	2.26
	1906	2.17	8.07	2.18
Hubbard's Royal Ensign	1905	2.10	7.72	4.81
	1906	2.41	7.04	4.02
Watson's Improved High Grade Potato Manure	1904	3.06	5.88	5.23
	1905	2.84	5.83	5.11
	1906	3.17	7.24	5.24
Lister's Animal Bone and Potash	1904	....	10.14	2.25
	1905	....	*10.42	1.96
	1906	....	10.50	2.06
Lister's High Grade Special for Spring Crops	1904	1.72	8.45	9.70
	1905	1.59	7.88	9.45
	1906	1.81	8.20	8.81
Lister's Oneida Special	1904	1.10	7.25	1.43
	1905	0.98	5.84	2.44
	1906	1.33	7.99	1.73
Lister's Potato Manure	1904	2.99	7.25	7.28
	1905	3.11	7.21	8.11
	1906	3.21	8.38	6.47
Lister's Special Corn Fertilizer	1904	1.92	8.69	3.18
	1905	1.64	7.50	3.03
	1906	1.99	7.91	3.20
Lister's Special Potato Fertilizer	1904	1.94	8.78	3.29
	1905	1.57	7.65	2.94
	1906	1.90	7.85	2.95
Lister's Success Fertilizer	1904	1.38	9.07	2.23
	1905	*1.28	8.63	1.94
	1906	1.39	9.42	2.47
Lister's 10% Potato Grower	1906	3.18	6.62	10.38
Chittenden's Complete Root Fertilizer	1904	3.25	9.17	6.62
	1905	3.14	7.86	6.79
	1906	3.14	8.12	7.67
Chittenden's Eureka Potato Fertilizer	1906	3.19	6.77	10.37
Chittenden's Excelsior Potato Fertilizer	1906	3.48	5.25	10.44
Chittenden's Market Garden Fertilizer	1904	2.68	6.16	5.20
	1905	2.48	6.72	5.50
	1906	2.30	6.62	5.11
New England Complete Manure	1905	3.04	*8.11	*9.40
	1906	3.31	7.16	8.30

* Guarantee changed in 1905.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
New England Corn and Grain Ferillizer	1904	1.36	7.07	2.21
	1905	1.34	7.32	2.34
	1906	1.29	7.21	2.17
New England Corn Phosphate	1904	1.56	7.00	3.05
	1905	1.50	8.37	3.00
	1906	1.75	8.35	3.10
New England High Grade Potato Fertilizer	1904	2.50	9.43	6.16
	1905	2.38	7.60	6.12
	1906	†2.41	8.41	6.44
New England High Grade Special with 10% Potash	1905	3.72	7.31	10.63
	1906	3.38	8.19	9.78
New England Market Garden Manure	1906	4.16	9.16	5.39
New England Potato Fertilizer	1904	1.96	7.56	4.15
	1905	1.57	7.18	4.27
	1906	1.92	8.06	4.23
New England Potato Grower	1906	2.28	7.18	9.74
New England Superphosphate	1904	2.24	9.36	4.21
	1905	2.06	8.59	4.15
	1906	2.42	9.87	3.93
Excelsior Potato Fertilizer	1905	3.13	6.87	11.62
	1906	3.41	6.37	9.73
P. & P. A. A. Brand	1904	3.53	8.05	8.80
	1905	4.14	7.26	7.82
	1906	3.98	8.23	8.24
P. & P. Aroostook Special	1904	3.90	6.93	9.95
	1905	3.44	6.82	10.13
	1906	†3.53	8.27	9.67
P. & P. Grain Grower	1904	0.98	5.10	2.00
	1906	1.01	7.48	2.30
P. & P. Potato Fertilizer	1904	1.82	5.24	6.10
	1906	1.66	6.83	4.90
Plymouth Rock Brand Fertilizer	1904	2.26	8.64	4.31
	1905	2.34	8.05	4.32
	1906	2.37	8.69	4.08
P. & P. Special Potato Fertilizer	1904	3.12	7.61	7.27
	1905	3.00	8.06	7.37
	1906	3.07	9.03	7.34
Star Brand Superphosphate	1904	1.48	6 69	2.24
	1905	1.66	6.63	3.32
	1906	1.52	7.53	2.62
Prentiss Aroostook Complete Fertilizer	1906	3.20	6.78	9.97
Prentiss Aroostook Special	1906	2.67	8.79	8.44
Prentiss Aroostook Standard	1906	2.19	9.12	5.11

† Guarantee changed in 1906.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Tuscarora Fruit and Potato Fertilizer	1906	1.59	8.46	9.32
Provincial Ten Per Cent Aroostook Complete Potato	1905	2.73	8.63	10.35
	1906	3.10	7.27	9.62
Provincial Special Potato Phosphate	1904	1.68	8.46	6.01
	1905	*2.08	8.04	*5.10
	1906	†2.39	7.28	6.25
Read's Potato Grower	1906	3.35	5.83	6.77
Essex A. 1 Superphosphate	1904	1.32	9.95	1.85
	1905	1.06	5.06	2.34
	1906	1.16	6.06	2.19
Essex Complete Manure for Aroostook County Crops	1906	3.37	9.34	9.58
Essex Market Garden and Potato Manure	1904	2.26	7.99	5.28
	1905	2.00	7.11	5.56
	1906	1.89	7.42	5.95
Essex XXX Fish and Potash	1904	2.38	7.99	2.28
	1905	2.10	6.94	2.28
	1906	2.28	6.81	2.57
Sagadahoc Aroostook Potato Manure	1904	1.38	5.94	4.27
	1905	1.08	5.24	5.56
	1906	1.29	6.96	3.39
Dirigo Grass and Grain Fertilizer	1904	0.67	10.12	5.32
	1905	*0.57	7.09	*2.41
	1906	0.87	6.96	5.18
Sagadahoc High Grade Superphosphate	1904	1.64	12.57	6.56
	1905	*1.68	*8.51	4.71
	1906	1.62	8.94	3.52
Sagadahoc Special Potato Fertilizer	1904	1 78	7.45	8.57
	1905	*2.06	6.68	8.22
	1906	1.83	8.91	7.52
Sagadahoc XX Chemical Fertilizer	1904	7.42	4.27	9.35
	1905	7.44	4.54	8.26
	1906	†8.02	7.79	8.07
Yankee Fertilizer	1904	0.66	9.22	2.98
	1905	0.60	8.25	2.01
	1906	0.74	9.37	2.38
3-6-10 Fertilizer	1906	2.11	8.38	9.34
Sanborn's Special Potato Fertilizer	1906	3.19	9.19	10.51
Scientific Potato and Vegetable Fertilizer	1905	3.30	7.10	6.45
	1906	3.87	7.22	7.43
Swift's Lowell Animal Brand	1904	2.38	9.56	4.23
	1905	2.18	9.37	4.03
	1906	2.37	10.66	4.22
Swift's Lowell Bone Fertilizer	1904	1.61	7.94	3.03
	1905	1.67	8.80	2.97
	1906	1.78	9.24	3.22

* Guarantee changed in 1905. † Guarantee changed in 1906.

Summary of results of fertilizer analyses for the years 1904, 1905, and 1906.

Name of fertilizer.	Year.	Total nitrogen.	Available phosphoric acid.	Potash.
		Per ct.	Per ct.	Per ct.
Swift's Lowell Cereal Fertilizer	1904 1905 1906	0.80 *0.82 0.86	6.19 6.44 7.21	1.29 0.95 1.19
Swift's Lowell Dissolved Bone and Potash	1904 1905 1906	1.68 1.59 1.61	9.13 8.10 10.42	2.17 2.24 2.10
Swift's Lowell Empress Brand	1904 1905 1906	0.79 1.24 1.32	6.85 7.37 7.50	2.05 2.16 2.15
Swift's Lowell Potato Grower	1906	3.11	7.29	10.55
Swift's Lowell Potato Manure	1904 1905 1906	1.78 1.64 1.72	7.32 7.31 8.61	3.96 3.90 4.65
Swift's Lowell Potato Phosphate	1904 1905 1906	2.43 2.30 2.40	8.10 7.55 8.19	6.21 6.00 6.13
Swift's Lowell Superior Fertilizer with 10% Potash	1905 1906	3.69 3.30	7.14 8.85	11.99 10.04
Whitman and Pratt's Vegetable Grower	1906	3.53	9.21	6.56
Whitman and Pratt's Potash Special	1906	†2.38	9.23	10.49

*Guarantee changed in 1905. † Guarantee changed in 1906.

Fig 16. Apple trees stripped by brown-tail moth, Winchester, Mass., June 9, 1905.

Photograph loaned by A. H. Kirkland

INSECT NOTES FOR 1906.

EDITH M. PATCH.

BROWN-TAIL MOTH AND GYPSY MOTH.

Since 1903 the brown-tail moth has become established throughout the Southern and most of the coast counties of Maine. In December, 1906, egg clusters of the gypsy moth were found in Kittery and Elliot. The caterpillars of the brown-tail moth are capable of ruining orchard, shade, and many woodland trees. They are also a dreaded nuisance because their hairs break off and on coming in contact with the human skin, cause extreme irritation and often illness. The caterpillars of the gypsy moth attack nearly every kind of vegetation and their work is especially fatal to pine and other evergreens since these trees always die after being once defoliated.

BROWN-TAIL MOTH.

So serious a pest should be known by every one in the State, because although extermination of this insect may not be possible, much practical and effectual work can be done in holding it in check and reducing its numbers to such an extent that damage to orchard and shade trees may be very slight.

For the past two years the State Department of Agriculture, the State Pomological Society, the Maine Agricultural Experiment Station, the town and city officials, and the citizens of the infested localities have worked in unison against the brown-tail moth. As a result this insect has not yet done very serious damage in this State, and the cases of poisoning have been very few. This is cause both for congratulation and encouragement for it shows that even if the brown-tail moth cannot be exterminated, its ravages may be in a large measure controlled. But the same distressing conditions threaten the State this coming year, and over a much larger district, and to be met successfully these conditions must be met as vigorously and as earnestly as they have been previously.

A simple warning to any one who may not be alive to the importance of fighting this insect is given in this bulletin by the significant photograph kindly supplied by Mr. A. H. Kirkland, State Superintendent for Suppressing the Gypsy and Brown-tail Moths in Massachusetts. The photograph, Fig. 16, shows apple trees stripped by caterpillars of the brown-tail moth, June 9, 1905, Winchester, Mass.

DESCRIPTION AND HABITS.

The moths. The moths, expanding from one and one-fourth to one and three-fourths inches, are white except for the abdomen, which is tinged with brown and tipped with a tuft of brown hairs. This tuft is small and dark in the male, but the large golden-brown tuft in the female is conspicuous enough to be the most striking characteristic of the moth, and has won for this insect its descriptive name of "brown-tail." These moths are on the wing in July, and unlike some closely related pests, the brown-tail females as well as the males are strong fliers. They are active at night, and as lights have an attraction for them, they sometimes fly a long way toward a lighted district.

The eggs. The female usually selects a leaf near the tip of the branch on which to deposit from 150 to 300 eggs. Some of the brown hairs from the abdominal tuft adhere to the egg-mass and give it the appearance of a brown felt lump.

The caterpillars in the fall. By the middle of August most of the eggs are hatched and the young caterpillars spin a slight web over the leaf near the egg cluster. From this protection they advance side by side, sometimes 200 tiny caterpillars feeding in an unbroken line, though they huddle together beneath the web when disturbed in any way. When they have eaten all but the skeleton of the first leaf, they draw another into the web and repeat the process at intervals during the late summer. They feed slowly, however, and spend so much time spinning their web that they do comparatively little damage to the trees in the fall, and they are still very small, (about one-fourth of an inch in length,) when cold weather comes on.

The Winter Nests. In the fall the young caterpillars weave additional layers of silk about their retreat, fastening it securely to the branch by the web, and pass the winter thus in colonies of 150 to 300. This is a very unusual yet most commendable habit in a caterpillar pest, for they can be killed, hundreds at a

Fig. 17. Winter nest of brown-tail moth with one attachment to twig.

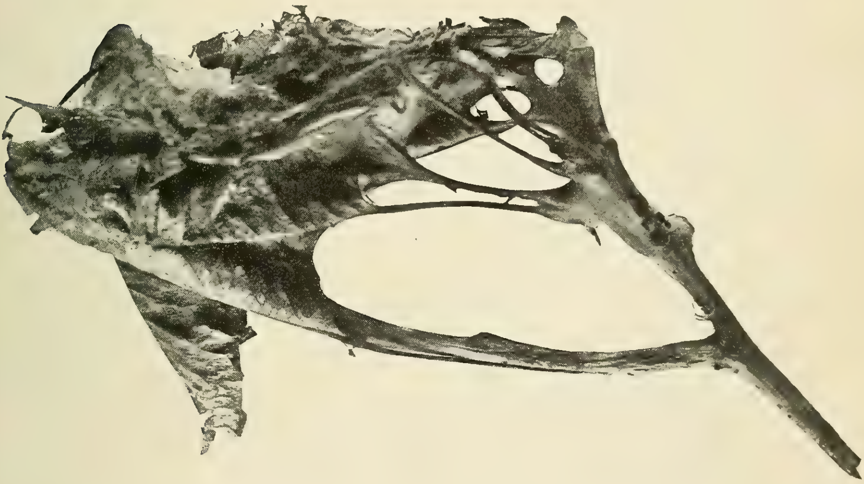

Fig. 18. Winter nest of brown-tail moth with several attachments to twig.

time, simply by burning the nests in which the colonies hibernate. The nests, composed of leaves bound firmly together by silken web, are varied in shape, those upon oak trees for instance being differently formed from those upon wild cherry, in accordance with the difference in the size and pliability of the leaves. They vary too, more or less, upon the same tree, in the number of attachments to the twig and somewhat in size. However, this variety in size and shape serves as a distinctive mark, as it distinguishes nests of the brown tail moth from the uniform and regular shaped cocoons of other moths found often upon orchard trees in winter. In spite of the superficial variety, the essential characteristics of the brown-tail moth nests are soon learned, and even anyone unfamiliar with the nest can make himself perfectly certain if he will cut carefully into the nest. *If the structure contains one or more silken cells filled with tiny living caterpillars it is the winter nest of the brown-tail moth.* Two types of the winter nests are shown in Figs. 17 and 18.

The caterpillars in the spring. Early in the spring the young caterpillars emerge from their winter nests and feed upon the opening leaf buds. Until about the middle of June they feed greedily upon the leaves, completely stripping the trees where they are numerous. Orchard trees are especially susceptible, but oak, elm, and many other shade and forest trees are often ruinously attacked. When full grown the caterpillars are about one and one-half inches long. They are dark brown with a sprinkling of orange. Long, fine reddish-brown hairs cover the body, and a row of conspicuous white hairs runs along each side. Like the caterpillars of the tussock and gypsy moths, they bear bright red tubercles on the top of the sixth and seventh abdominal segments.

Poisonous qualities of the caterpillars. Were the caterpillars to be feared only for their ravages upon orchard and other trees, the situation would be alarming enough, but not less serious is the physical discomfort experienced by people living in infested districts. When the minutely barbed hairs of the caterpillar come in contact with the skin they cause an eruption similar to and in many cases worse than ivy poisoning. These hairs are brittle and where the caterpillars are numerous few people are likely to escape, as the caterpillars drop from the branches and creep about, even entering houses. Direct contact with the insects themselves is not necessary however, for when the cater-

pillars shed their skins the molts are blown about, widely scattering the barbed hairs. Thus in infested districts it is no uncommon occurrence for whole families to suffer from the rash caused by the hairs which settle upon clothes hung out to dry. Children gathering cherries are badly "poisoned," and people have been obliged to leave their homes for uninfested places in order to recover from attacks of the "caterpillar rash," which sometimes results in serious illness.

The cocoon. The caterpillars are usually full grown in June. They then spin loose cocoons, attached commonly to leaves, though sometimes other shelter is sought. Within these they transform to brown pupæ about three-fourths of an inch long. From the first to the twentieth of July the moths with pure white wings and brown-tipped abdomens emerge from these cocoons to deposit eggs for the next generation of caterpillars.

REMEDIAL MEASURES.

Natural Enemies. In the course of time, the natural enemies may become established also and take their share in the work. Doctor Howard, Chief of the Bureau of Entomology, and Mr. A. H. Kirkland, Massachusetts Superintendent for Suppressing the Gypsy and Brown-tail moths, are uniting their efforts in introducing parasites of these moths from European countries. Results from such work are necessarily slow and though the parasites may in time become a most effective means of lessening the numbers of these introduced pests, as parasites already do with many native moths, for the present season at least they cannot be expected to serve for a substitute for other remedial measures.

Cutting and burning the winter nests is the most important of the remedies because it is the easiest, cheapest, and, if thoroughly done, a sufficient protection against the ravages of this pest. The webs and leaves that compose the nest are woven tightly to the tips of the branches and hang there like dead leaves all winter. With so many months for inspection there is no excuse for harboring the hibernating caterpillars on shade or orchard trees. After they are cut from the branches, the nests should be burned, as this is the simplest way of destroying the colony within.

Destruction of breeding places. Much can be done in infested districts by clearing out wild cherry tangles and other growths which serve as a breeding place for these moths.

Spraying. The caterpillars are readily killed by arsenical sprays. The remedy is most effective when applied as soon as the leaves develop in the spring. Of course where the winter nests have been destroyed there will be no need of this remedy and it is much easier to kill about 200 caterpillars enclosed in a nest than to wait until they are scattered over the tree.

Legislation Against the Brown-tail and Gypsy Moths.

Legislation in Maine. In Maine the alarming invasion of the brown-tail moth during 1903 and 1904 emphasized the need of legislation against the ravages of dangerous insects and diseases, and in February, 1905, an act was passed to provide for the inspection of nurseries and incoming nursery stock, and placed with the Commissioner of Agriculture the duty of investigating any locality where the presence of dangerous insects or plant diseases may be suspected.

National Legislation. Appreciating the necessity of combating the brown tail and gypsy moths which threaten not alone the New England States, but the vegetation of the whole country, the last United States Congress passed an emergency appropriation of $82,500 to be used in preventing the further spread of these insects as far as possible.

Aroostook Potato Insects.

Wherever native vegetation is destroyed over a large area and a cultivated crop substituted, the equilibrium of insect conditions is upset, and a readjustment ensues If the plant-feeding insects of the locality are able to adapt themselves to a diet of the cultivated crop, the readjustment is of economic interest.

The potato fields of Northern Maine present an opportunity for observation along this line. Approximately 6,000 acres have been opened to the potato crop in Aroostook County during the past 16 years. What has become of the insects originally feeding upon other vegetation over these 6,000 acres is chiefly a matter of fruitless speculation. In general they have died, changed their location, or accepted the potato as an article of diet.

The inevitable Colorado potato beetle is taken philosophically here as elsewhere as a part of potato culture, and certain

fields kept clear of it by adequate spraying and, especially late in the season, certain fields given over to its ravages with apparent indifference.

Tomato Flea Beetle. Probably more serious injury to the potato vines is inflicted by the common tomato flea beetle, *Epitrix cucumeris,* than is generally credited to this insect by potato raisers, as it is found upon the leaves during the whole season, often in enormous numbers, and the punctured and riddled leaves cannot of course do full duty in such a condition.

Smartweed Flea Beetle. In addition to these two foregoing omnipresent pests, the Aroostook fields possess some more distinctive features. About the middle of September the smartweed flea beetles, *Systena hudsonias* were even more numerous than the smaller species. Both at Caribou and Houlton they were especially abundant and a potato leaf untouched by them could scarcely be found.

Cosmopepla carnifex. A pretty black and red bug, *Cosmopepla carnifex,* content before the advent of the potato to feed upon tender poplar shoots, and mint and buttercup stems, has shown no hesitation in accepting the new feeding grounds. By way of illustration it may be cited that on Sept. 12 at Caribou 11 of these bugs were found with their beaks deep in a single potato stalk. The bugs looked healthier than the stalk.

Pentatoma juniperina Linne. This large green bug, not uncommon in the State upon evening primrose, was found upon the potato, at Caribou July 11, where it was accused of wilting the stalk.

Tarnished Plant Bug. The tarnished plant-bug, *Lygus pratensis,* of evil reputation everywhere, is guilty of various annoyances in Maine. In some parts of the State, pear trees suffer through serious attack of the swelling leaf and flower buds in the spring. In a second the aster buds are "buttoned" by this bug so that "no perfect flowers can be obtained for sale." From a third, complaints accompanied by tarnished plant-bugs, state that all of many dahlia blossoms are deformed,—opening feebly only on one side. At Portland they were thick upon celery. The adults of this species can be startled from goldenrod blossoms almost anywhere in the State. It is not surprising to find such an adaptable insect taking without question the food offered it over thousands of acres of potato vines. About the middle of September different fields over a stretch of 7 miles

near Houlton were visited. All these fields were infested by the tarnished plant-bugs, and in one field visited early in the morning before the insects had warmed up enough to be much on the wing 40 or 50 plant-bugs to a single plant was not an unsual number. This fact seems an alarming one, for though the injury so late in the season may not be of grea: importance, the hibernating adults, if they attack the early tender shoots in the spring as is their habit on other plants, will cause much deformed and stunted growth another season. The tarnished plant-bug is not an easy foe to meet. Paris Green or other stomach poisons are useless against an insect with sucking mouth parts. Kerosene emulsion or other contact remedies are not practical for a pest which is so easily startled to flight. At the slightest disturbance the plant-bug is on the wing and in condition to return to the plants when the danger is over. From certain garden plants the plant-bug can readily be shaken onto a cloth or into a pan containing kerosene, early in the morning or on cold days when they are too sluggish to be easily alarmed. Such a means would, of course, be impractical in a potato field. There remains apparently but one vulnerable point, based upon the fact that the tarnished plant-bug hibernates in the adult condition among weeds or other rubbish. The custom of potato raisers of raking up and burning the old vines in the fall in order to have fields clear for fall plowing is therefore one of the most effectual ways of destroying the shelter of these bugs. If, in addition to clearing away the old vines, the weeds and rubbish along the edges of the potato fields should be burned on a cold day, great numbers of the tarnished plant-bugs would be destroyed with comparatively little cost and time. If the plant-bug continues to appear upon the potato vines, this means of combating it should be resorted to regularly each fall.

Nectarophora solanifolii. In a land flowing with honey dew as has been the whole State of Maine for several years past, even the potato cannot hope to escape aphid attacks. A large green species, *Nectarophora solanifolii* Ashm. has for 3 seasons attacked the potato vines in the vicinity of Houlton and elsewhere to an injurious extent. The colonies cluster thick on stem and leaf, thousands to a plant, frequently wilting the stems and drying the leaves. The worst of the attack comes between the middle of August and the middle of September in time to weaken the plant and thus effect the growth of the tubers. The

true sexes of this species do not appear upon the potato. It is not yet known what plant serves for the alternate host.

Aphis sp. This present season in some parts of Aroostook, conspicuously at Caribou and vicinity, a second species of plant louse, an undetermined and probably a new species belonging to the genus *Aphis,* has heavily infested certain fields. They were beginning to appear upon the vines about the middle of July and they had not all taken flight by the middle of September. At the later date colonies of pupæ could be found here and there at Caribou, clustered thick enough on stalk tip and new growth to hide the stalk. The bodies of these pupæ shaded from pink to salmon and from green to brown. They seem invariably to feed head down.

The presence of plant lice to such an extent upon potato vines raises several perplexing problems. If a fairly uniform attack could be reckoned on each year, the cost, benefit and practibility of emulsion sprays on the infested fields would be well worth testing. Plant louse attacks, however, are likely to be irratic, influenced by climatic conditions and by decrease and increase of parasites and predaceous insects. As yet it seems to be an open question as to whether it is most practical to attempt to combat the aphids in the potato field by artificial means, or leave them to fluctuate according to natural influences. At any rate their presence is to be regretted. Even a light attack which would not preceptibly weaken the plant, probably renders it more susceptible to fungus diseases than it would normally be. For the past 3 years the aphid attacks on potato have been widespread. Dr. James Fletcher, Central Experimental Farms, Canada, writes from Ottawa, September, 1906, "The aphis has been extremely abundant on our potatoes all through this part of Canada this year." It also troubled Canadian fields in 1904.

Alder Blight and Attendant Insects.

A conspicuous illustration of the natural fluctuations of insect conditions is given by *Pemphigus tesselata* in the vicinity of Orono. This species, a large dark bodied plant louse infesting the trunks and branches of alder (*Alnus incana*), is often mistaken for fungus on account of the snow-white flocculent matter with which it is covered. For several seasons the alder clumps here as in many other parts of the State have been white stemmed with this woolly plant louse, and early in September the air has been alive with the winged forms.

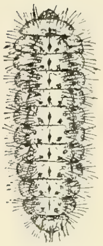

Fig. 19. The Harvester.
Larva x 2.

Fig. 20. The Harvester.
Chrysalis x 2.

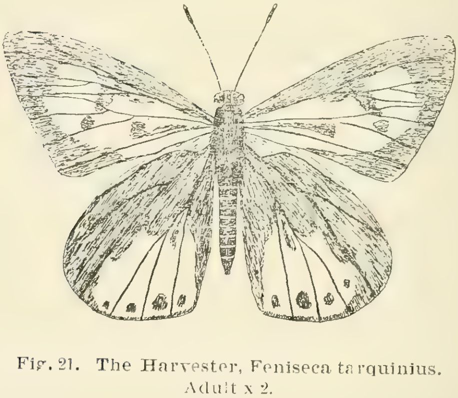

Fig. 21. The Harvester, Feniseca tarquinius.
Adult x 2.

Syrphus maggots. The chief enemy which had for two seasons confronted the "alder blight" was a syrphus fly, which could be seen hovering near the colonies for the purpose of depositing eggs. The maggots hatched from these eggs fed greedily upon the large soft bodied plant lice, but the enormous numbers of the plant lice did not seem to be materially lessened. The winged forms were plentiful last fall, 1905. This spring the colonies were common but not so numerous as for several seasons past. The syrphus maggots work industriously and often white "wool" upon the alder stems was found to cover more maggots than plant lice. It seems likely that the syrphus flies could clear the vicinity of "alder blight." Late in the summer, however, it was discovered that the syrphus flies no longer had the "alder blight" to themselves. A rival appeared in the form of the Harvester butterfly.

The Harvester, Feniseca tarquinius. (Fig. 19). During September caterpillars of the Harvester could be taken in almost any colony of "alder blight" in the neighborhood. Like the syrphus maggots, these caterpillars burrow beneath the woolly secretions of the plant lice and are covered from sight. The full grown caterpillar is slightly more than one-half inch in length and slug like in shape. The body is drab colored and the head a shiny brown. The 12 segments of the body are deeply creased and scalloped along the lateral margin. There is a mid-dorsal line of black dots with an orange spot at each side. Each orange spot is lined laterally with black. The body is well covered with black bristly spines to which flocculent masses from the alder blight becomes attached. The curious chrysalis (Fig. 20) of this insect is a half uncanny, wholly fascinating little object with the dorsal aspect possessing a remarkable resemblance to a monkey's face. The adult butterfly (Fig. 21) expands about one and one-fourth inches. The colors of the upper surface of the wings are black and tawny. The black spots are subject to much variation in form and size.

So industriously did the Syrphus maggots and the Harvester caterpillars feed upon "alder blight" that by the end of September hardly a colony of this plant louse could be found in the vicinity of Orono.

Alder blight covered by ants. In connection with a series of observations which were being made this season on alder blight, an interesting bit of ant work was noticed August 30. A colony

of ants had its quarters in some small decaying tree trunks fallen at the base of a clump of alder. Two of the alder stems were thickly infested with *Pemphigus tesselata* much visited by ants for the honey dew. In this case the ants had built a covered tunnel from the base of the alder stems to the distance of nearly 2 feet on one stem and more than one foot on another. This structure was composed of sawdust-like particles and enclosed small clusters of the aphids which seemed undisturbed by the proceedings. The stems were upright and one ant tunnel was erected vertically along the stem while the second was more or less winding. The ants varied their occupation of extending the tunnel with sipping upon the convenient honey dew. Specimens of these ants were identified by Mr. Theo. Pergande of the U. S. Department of Agriculture as *Lasius mixtus* Mayr.

LARCH CASE-BEARER, *Coleophora laricella* Hbn.

Throughout Washington, Hancock, and Penobscot counties at least, and probably over a larger area a very minute moth has been to work on the larch, (*Larix americana*), or hackmatack, or tamarack as it is variously called.* The insect winters in the larval stage upon the larch and attacks the tender needles when they first start in the spring. Although minute they have been present in such enormous numbers that larch trees have often been, during the past 3 seasons, eaten bare of green early in the spring. The caterpillars feed by eating a hole in the side of the needle and then devouring as much of the inner portion as it can reach. It thus has the characteristic manner of feeding common to related leaf miners. The injured needles often continue to grow but the clusters are ragged and many of the needles brown and dry. Small larches in the vicinity of Bangor and Orono which have been subjected to an attack of at least 3 seasons died this summer from no other apparent cause than the presence of great numbers of the case-bearers which kept the needles eaten off. Many large larches infested by this insect look yellowish and unhealthy.

The larva. The caterpillar is a case-bearer, that is, it protects its body with an external covering or case. The larch case-

* Although so well supplied with popular names of its own, this tree is also erroneously but very commonly called the juniper in Maine.

bearer uses a bit of dried spill from the larch for its case and from this protection it extends its head and thoracix feet when it wishes to move about or feed. Along the ventral side the spill is split and pieced together with silk woven by the tiny caterpillar. As it grows it weaves an extension of this silk on the anterior part of the case. The full grown caterpillar is about 3 millimeters * in length. The case measures 4 millimeters or 5 millimeters. The caterpillars are much more active during warm and sunny weather, and during cold days they do no feeding. When fall comes on the nearly grown caterpillars in their little spill cases attach themselves to the bark and about the bud angles and live dormant for the winter. With the first warm days of spring the caterpillars become active and feed upon the soft tender larch needles. As the caterpillars are nearly full grown this is their most vigorous feeding spell and as the larch needles are eaten when they first begin to grow, it is a particularly hard season of the year for the tree to endure such an attack. The same number of case-bearers later in the season would by no means create so much damage.

The full grown caterpillars do not leave their cases but attach them to the twig or commonly in the cluster of needle shaped leaves where they are not easy to find and let the cases serve for a cocoon.

The moth. In the vicinity of Orono the adult insect emerges about June 4. They are a glistening ash gray in color. The wings are slender and the hind wings have the deep delicate fringe common to this group of moths. It expands about 9 millimeters. This moth is something the shape of the common clothes moth and a little smaller. The female deposits the eggs in among the larch needles and the young naked caterpillar eats its way into a needle and after disposing of the soft interior as food, uses the empty shell for its case.

There is fortunately but one generation a year. Observations upon these case-bearers about Orono had been made during 2 seasons when Dr. James Fletcher, Central Experimental Farm, Ottawa, published his interesting account of the appearance of the Larch case-bearer, *Coleophora laricella* in Canada (Report 1905). Doctor Fletcher kindly compared specimens bred in Maine with the Canadian *Coleophora* and pronounced them undoubtedly the same species. Ratzeburg in his Forst-Insecten

* One inch nearly equals 25 millimeters.

gives excellent figures in color of the larva, moth, and work of *Tinea laricinella* which if it is not the same species as *Coleophora laricella* so closely resembles it that the same figure would serve for both.

There would not seem to be any practical remedy against this insect in large growths. Since it eats the inner portion of the needles and leaves the epidermis, arsenical sprays would hardly avail on the larches used for ornament. In nurseries, badly infested trees should be burned. From very small trees the majority of the cases could be removed by hand during the winter. Japanese Larches * are said to be immune from attack by this case-bearer.

Miscellaneous Notes.

Of the many insects which naturally come under observation during the season, a few are conspicuous for various reasons, as the attendance of particular parasites, the occurrence in great numbers of an insect not usually abundant, or the appearance of an insect on some plant it does not commonly attack. Such instances are often of more than passing interest and are conveniently recorded under miscellaneous notes of the year.

Yellowhead Cranberry Worm on Sweet Gale. The yellowhead cranberry worm, *Teras minuta,* was present this season over cranberry beds near Charlotte. The culture of these beds had been somewhat neglected and sweet gale, *Myrica gale* had crowded into the beds from all directions. The tips of the sweet gale were everywhere conspicuously spun together and examination showed the culprit to be the yellowhead cranberry worm which was working also in the cranberry vines. The pest was attacking the sweet gale to a much greater extent than it was the cranberry itself. This fact was so marked that it suggested, as apparently practical, a simple remedial treatment for this locality. It was recommended that all of the sweet gale, which was injuring the cranberries by its presence as a weed, should be torn out except strips of it near the edges of the beds which were to be left as a trap. The sweet gale, left as attractive bait for the yellowheads, could be treated to a heavy spray of arsenate of lead early in the spring, in time for the first brood of larvæ, thus killing in small space the majority of the pests. The beds, it should be stated, are in a dry bog and resort

* Insect Life. Vol. IV. Page 405.

to flowing would mean considerable expense. The same insect was present at Charlotte upon apple trees but not to a great extent.

The Apple Maggot and the Codling Moth. Both these insects are at work in this State to a regrettable and injurious extent. There is considerable confusion among orchard owners as to the character and names of these two pests. The term " apple maggot " is unfortunately applied indiscriminately to the larva of " Trypeta " and the codling moth, and the term " railroad worm " is not much more definite, especially if the trails extend away from the surface of the apple. The present season one man reported that nearly all his apples were " ruined by the ' railroad worm ' or ' wire worm' as it is sometimes called." In view of such confusion the following brief statement may not be amiss.

" Apple maggot," " railroad worm," and " Trypeta " should all properly apply to the larva of a striped winged fly, *Rhagoletis* (*Trypeta*) *pomonella*. This larva is a *maggot,* a small but plump, white, footless object with head so ill defined that it is difficult to find at all, and the mouth parts reduced to a pair of hooks. The apple maggot works in soft discolored mushy trails anywhere in the pulp of the apple. When these trails lie immediately under the skin of pale skinned apples they show through like tiny but clearly defined tracks, and the descriptive term " railroad worm " has been given the maggot which travels along these tracks. The trails of the apple maggot never contain little round sawdust like pellets, and they do not extend into the core of the apple.

The codling moth (*Carpocapsa pomonella*) is a true moth. The fore wings are irregularly streaked with gray and brown, and have a horseshoe marking of copper color at the inner angle. The hind wings are of light yellowish brown. The moth expands about three-fourths of an inch. The larva of this moth is a tiny naked *caterpillar* with clearly defined head region and three pairs of legs upon the segments immediately behind the head. It has the ordinary biting mouth parts of other caterpillars and resembles the closely related leaf folding caterpillars (Tortricids) in its motions, wiggling violently backward when disturbed. The larva of the codling moth makes excavations in the apple, extending them usually into the core itself. These excavations always contain little, round, brown, sawdust-like, pellets which are the excretions of the larva.

The apple maggot and the larva of the codling moth are often present in the same apple. Discussions of the life history, habits and remedies of these two pests are given in other available bulletins of this Station and are therefore not repeated here.

Lace Bugs. The recently described * Tingitid, *Corythuca pergandei* Heid. was extremely numerous upon willow and alder (*Alnus incana*) between Bangor and Orono this season.

Infested Spruce Cones. Late in August the cones on the Norway spruces on the campus were observed to be dropping prematurely. Examination showed a general infestation by a Lepidopterous larva about seven-eighth of an inch in length. Some were a uniform purplish brown, others showed a greenish color on the thoracic segments with 2 tiny black spots on the first segment behind the head. These larvæ began spinning cocoons about the middle of September. The cocoons are the color and transparency of thin white tissue paper. The average length is about one-half inch and they are usually about one-fourth of an inch wide, though sometimes the cocoons are nearly as broad as long. Pupation does not take place at once but the caterpillar, readily seen through the thin cocoon, lies for days in a U shaped loop. If the cocoon is disturbed, the caterpillars break through and travel off actively and with apparent irritation. The infested cones were prematurely brown in the vicinity of the larval tunnels. The excavations were chiefly at or near the center of the cones, from one to several larvæ being present in a single cone. Through the kindness of Doctor Howard specimens were referred to Mr. Fiske (Bureau of Entomology, Washington, D. C.) who stated them to be evidently a species of Pinipestis, mature moths being necessary for full determination.

Maggots which were attacking the decaying portion of the cones infested by these caterpillars developed in abundant numbers into *Drosophila amœna* Loew, kindly determined by Mr. D. W. Coquillett. This small red-eyed fly with yellow thorax and dark abdomen, and wings crossed with 2 dusky bands, is not uncommon about decaying fruit.

Harvest fly, *Tibicen rimosa.* A very pretty harvest fly, or cicada, belonging to the same genus as the periodical cicada was common in the vicinity of Orono from the middle to the latter part of July. (A photoghaph of this species is given as Fig.

* Proceedings of the Entomological Society of Washington, Vol. VIII Nos. 1-2.

Fig. 22. Harvest fly or Cicada, *Tibicen rimosa* Say. *noveboracensis* Fitch. Very slightly enlarged. Photograph of specimen taken at Orono, July 31, 1906.

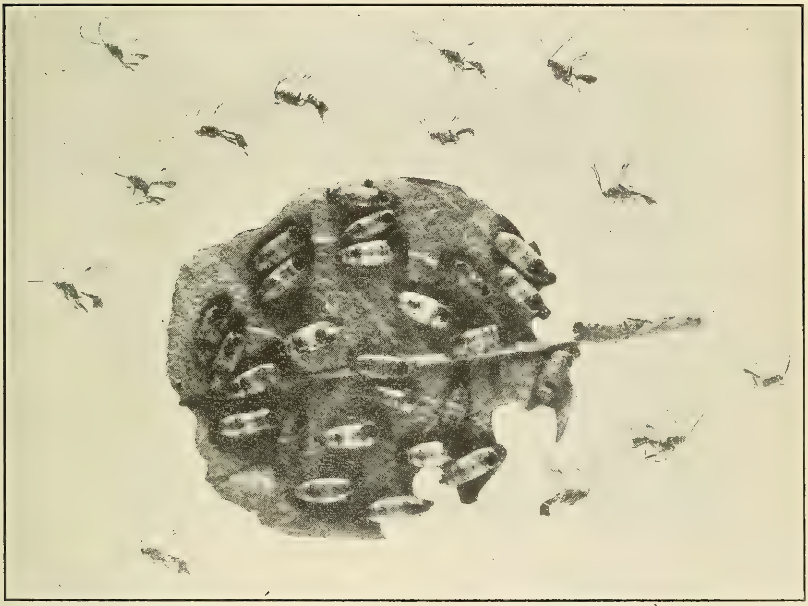

Fig 23. Parasited specimens of young red humped caterpillars attached to apple leaf, and parasites, (*Limneria guignardi*, Prov.), which emerged from them. Photographed from specimens taken at West Minot, August 29, 1906.

22.) The head and thorax have clearly defined marks of deep orange yellow, along the posterior margin of each abdominal segment is a narrow but distinct line of the same color, and the wings near the body are clouded also with orange. The expanse of wings averaged about 2 and one-half inches. The species was kindly determined by Mr. Heidemann as *Tibicen rimosa* Say, var: *noveboracensis* Fitch.

Diamond-back Moth, Plutella cruciferarum, as a Greenhouse Pest. Early in April a complaint came from a greenhouse in Ellsworth of a small green caterpillar which destroyed ten weeks stocks, working on leaves and flowers. Specimens were received with the communication and were bred to the adult stage, part of them proving to be the light form and part the dark form of the Diamond-back. On May 24, a new lot of these larvæ were received from the same source again at work upon the stocks. This species, described with reference to materials bred on stocks in greenhouse, is as follows:

The caterpillars when full grown are three-eighths of an inch in length. The color is a light green with the head concolorous or sometimes shading to yellowish. The median dorsal line is a more vivid green. To the naked eye they appear smooth, but a low power glass reveals stiff dark hairs rising from lighter spots arranged in a regular manner upon the segments, These hairs are most numerous upon the last thoracic segment. The last pair of abdominal pro-legs are extended back horizontally giving the body a forked appearance. The pupal stage is passed within a very delicate white, gauzy cocoon through which the pupa is readily seen. Some of the specimens reared passed but 6 days in the pupal stage.

The perfect insect is a moth expanding about five-eighths of an inch. The fore wing is ash colored with minute dark spots upon it. A yellowish stripe outlined with a dark line extends along the hinder margin in such a manner that when the wings are closed, 3 light colored diamond shaped markings are formed. Both pairs of wings are a uniform gray on the under side. The antennæ are marked with alternate rings of white and dark.

The Diamond-back is an imported moth and it occurs frequently upon cabbage and cauliflower in the garden. Doctor Fletcher reports * the Diamond-back to be an incessant and most troublesome pest upon garden stocks and wall-flowers

* Can. Exp. Farms 1890, p. 165.

from about July till the frosts in November. The remedy most frequently recommended is kerosene emulsion.

The greenhouse infestation at Ellsworth started on stocks that had been transplanted from outside and the larvæ were probably taken in with them, successive generations developing within doors. Hand picking proved to be a perfectly effectual remedy though a tedious task.

Six Troublesome Orchard Insects. The yellow-necked caterpillar, *Datana ministra,* and the red-humped caterpillar, *Œdemasia concinna,* have created much alarm in Maine this year. Entire orchards have been despoiled by these pests. Young trees have suffered the worst injury not because the caterpillars show a preference for them, but because one brood is sufficient to strip a small tree, and the same number of leaves from a large tree does not mean so serious a loss. *The bud moth, Tmetocera ocellana,* is at present doing much damage in Maine orchards. Two species of tussock moths, *Notolophus leucostigma* and *antiqua* have been abundant in most parts of the State as has the orchard tent caterpillar.

Limneria guignardi Prov. The red-humped caterpillars have been in the southern counties abundantly attended by an ichneumon parasite, *Limneria guignardi* Prov.* These parasites attack the young caterpillars in the early stages, at which time the caterpillar is just the right size to serve for food for a single parasite. The parasite grub when full grown forms its cocoon within the empty skin of the caterpillar which fits tight over the cocoon. The caterpillar head being still attached, the object is a curious one. When about to emerge the adult parasite gnaws a hole at one end of the cocoon and takes wing. This hole is sometimes near the head and sometimes near the caudal end of the caterpillar skin. See Fig. 23.

Yellow-edge Butterfly. From York to Aroostook counties the spiny caterpillars of the yellow-edge butterfly, *Euvanessa antiopa,* have been common on elm and willow. This species has been almost constantly mistaken for gypsy caterpillars, and has been the cause of numerous false alarms. A brood is occasionally found upon apple trees, but it does not seem likely to become an orchard pest, its preference is so evidently for willow

* Determined by comparison with Canadian material through the kindness of Doctor Fletcher.

and elm. A Tachina parasite is active against these caterpillars in Maine.

Garden Fleas. In contrast with the past two seasons no observations of the garden flea, *Smynthurus albamaculata,* Harvey were made. During the early spring, at the time these minute insects have previously been most conspicuous, continuous rains prevented field observations on such insects as these. The account of injury due to this species given in Bulletin No. 123 of this Station, page 220, was the occasion of several requests from specialists in this group for reference to the original description. Professor Harvey's description together with drawings by Mr. J. H. Emerton were published in the Report of this Station for 1896, pages 124-126.

Mosquitoes. There is no adequate record of Maine mosquitoes although in many parts of the State certain species are excessively troublesome. A few collections were made this season and sent to the Bureau of Entomology, Washington, D. C., where several specialists are at work on this family. Doctor Dyar kindly determined them as follows:

Anopheles punctipennis Say. Orono, July 27 and October 1, about light in house.

Anopheles quadrimaculatus Say. Orono, September 20, in house.

Aëdes fuscus O. S. Orono, July 27.

Aëdes canadensis Theob. Trenton, August 10; Caribou, August 17.

Aëdes sylvestris Theob. Trenton, August 10.

Aëdes sollicitans Walk. Trenton, August 10.

Aëdes abfitchii Felt, *fitchii* Felt, or *subcantans* Felt. (Adults alike—need larvæ to separate). Orono, August 3; Trenton.

All of the species of *Aëdes* except *fuscus* given in the foregoing list were until recently commonly referred to the genus *Culex.*

Insects for Identification. A few, only, of the large number of insects received for identification this season are recorded in the following pages.

Such common, widespread, and constantly occurring forms as the cecropia moth and oyster-shell scale have been omitted. Such information as the increasing parasitism of the red-humped caterpillar has been summarized in a single statement elsewhere in the bulletin rather than listed as 70 or 80 separate items.

INSECTS RECEIVED FOR IDENTIFICATION.

Name.	Date.	Host.	Locality.	Remarks.
Nessus sphinx, *Amphion nessus*	June 14		Orono	Adult.
Galium sphinx, *Deilaphila chamænerii.*	June 14		Orono	Adult.
Wild cherry sphinx, *Sphinx drupiferarum*	June 16		Orono	Adult common.
Thysbe Clear-wing, *Hemaris thysbe*	June 18		Surry	Moth on lilac blossom.
Azalea sphinx, *Ampelophaga choerilus*	June 29		Bar Harbor	Male
Small eyed sphinx, *Paonias myops*	July 14		Orono	Adult.
Big poplar sphinx, *Marumba modesta*	July 13		Orono	Adult.
Pen marked sphinx, *Sphinx chersis*	July 14		Bangor	Female.
Apple sphinx, *Sphinx gordius*	July 17		New Vineyard	Female.
Laurel sphinx, *Sphinx kalmiæ*	July 27		Orono	Adult.
Morning sphinx, *Deilephila lineata*	Aug. 1		Eden	Larvæ full grown.
Twin spotted sphinx, *Smerinthus geminatus*	Aug. 1		Waterford	Adult.
Woodbine sphinx, *Pholus achemon*	Aug. 14	Woodbine	North Berwick	Larvæ "appear every year".
Four horned sphinx, *Ceratomia quadricornis*	Sept. 1		Houlton	Larva.
Walnut Datana, *Datana angusii*	Aug. 22	Walnut	North Berwick	Larvæ numerous, specimen parasited.
Walnut Datana, *Datana angusii*	Aug. 27	Walnut	North Berwick	Trees entirely stripped of leaves.
Unicorn prominent, *Schizura unicornis*	Aug. 22	Apple	Green	
Unicorn prominent, *Schizura unicornis*	Aug. 28	Apple	Jonesboro	
Unicorn prominent, *Schizura unicornis*	Sept. 1	Apple	Deer Isle	
Unicorn prominent, *Schizura unicornis*	Aug. 14	Apple	North Jay	
Hag moth, *Phobetron pithecium*	Aug. 2		North Buckfield	Cocoon.
Yellowhead cranberry worm, *Teras minuta*	Aug. 29	Cranberry	Charlotte	Larvæ numerous.
Lesser apple leaf folder, *Teras minuta*	June 21	Apple	Foxcroft	Larvæ numerous in orchard.
Fork-tailed caterpillar, *Cerura borealis*	Sept. 7		Weeks Mills	Larva.
Apple Bucculatrix, *Bucculatrix pomifoliella*	Sept. 10	Apple	East Corinth	Ribbed cocoons numerous.
Apple Bucculatrix, *Bucculatrix pomifoliella*	Oct. 15	Apple	Manchester	Ribbed cocoons.
Hickory tiger moth, *Halisidota caryæ*	Sept. 17	Apple	Drew	
Lappet moth, *Tolype velleda*	July 31		East Orrington	Larva full grown.
Beautiful wood nymph, *Eudryas grata*	Aug. 6		Hampden Corner	Adult.
Pearly wood nymph, *Eudryas unio*	July 23		Orono	Adult.
Tussock moth, *Notolophus leucostigma*	Aug. 7	Raspberry	Norridgewock	Much damage.
Fingered dagger moth, *Acronycta dactylina*	Aug. 18		Ellsworth	
——— *Acronycta americana*	Sept. 7	Maple	Bar Harbor	Larva.
Crompton tortoise, *Vanessa j-album*	Sept. 23		Charlotte	Adults very common.
The Relict, *Catocala relicta*	Sept. 9		Orono	Adults on birch bark.
Scalloped Owlet, *Scoliopteryx libatrix*	Feb. 16		Gardiner	Dead moth.

Diamond back moth, *Plutella cruciferarum*	April	2	Stocks	Ellsworth	Larvæ destructive in greenhouse.
Budmoth, *Tmetocera ocellana*	June	13	Apple	Turner	Larvæ.
Spruce tortrix, *Tortrix fumiferana*	June	20	White spruce	Bar Harbor	Larvæ.
Larch case bearer, *Coleophora laricella*	June	26	Larix americana	Machias	Larvæ seriously stripping trees.
Cherry tree leaf folder, *Cacœcia cerasivorana*	July	2	Wild cherry	Waterford	
Cherry tree leaf folder, *Cacœcia cerasivorana*	July	13	Wild cherry	Skowhegan	Nest and pupæ.
Oak ugly nest, *Cacœcia fervadana*	Aug.	1	Oak	Bar Harbor	Nest, larvæ and pupæ.
Stalk borer, *Papaipema nitela*	July	14	Sweet corn	Cape Elizabeth	Destroying much.
Primrose moth, *Rhodophora florida*	July	27		Orono	Moths common in closed flowers of œnothera biennis.
Twice stabbed Lady beetle, *Chilocorus bivulnerus*	Aug.	29	Plant-lice	Ellsworth	Numerous.
15-spotted Lady beetle, *Anatis 15-punctata*	June	7	Plant-lice	New Vineyard	On house plants.
Saw-tooth grain beetle, *Silvanus surinamensis*	March	15	Flour	Farmington	
White grubs, *Lachnosterna*	June	5	Grass roots	Harrison	Grubs worked two acres grass land so that it plowed like old ground.
Asparagus beetle, *Crioceris asparagi*	Sept.	17	Asparagus	Brunswick	¼ acre completely stripped by middle of August.
Beautiful maple borer, *Plaginotus speciosus*	July	18	Maple	Unity	
——— *Malachius æneus*	June	20		Orono	Identified by Dr. Chittenden.
Tortoise beetle, *Coptocycla signifera*	July	24	Convolulus sepium	Orono	Numerous.
Tortoise beetle, *Coptocycla purpurata*	Sept.	13	Convoullus sepium	Orono	Numerous.
Spindle gall, *Pomphigus ulmi-fusus*	July	13	Elm	North Berwick	Numerous.
——— *Pemphigus populimonilis*	Aug.	14	Poplar	Bar Harbor	Galls.
Pineapple gall, *Chermes abietis*	Aug.	1	Spruce	Portland	Galls numerous.
——— *Chionaspis salicis*	Sept.	15	Viburnum alnifolium	Houlton	Thickly infested.
——— *Eulecanium quercitronis*	June	23	White oak	Freedom	In great numbers.
Pear tree Psylla, *Psylla pyricola*	Sept.	1	Pear	Pittsfield	Work on pear leaves.
——— *Pentatoma juniperina*	July	11	Potato	Caribou	Feeding on the stalk, wilting it.
Four-lined leaf-bug, *Pœcilocapsus lineatus*	July	24	Geranium	North Berwick	Troublesome every year.
Tarnished plant-bug, *Lygus pratensis*	Oct.	1	Celery	Portland	Numerous.
Tarnished plant-bug, *Lygus pratensis*	Sept.	15	Potato	Houlton	Enormous numbers.
Tarnished plant-bug, *Lygus pratensis*	Sept.	23	Dahlia	Charlotte	Deformed and buttoned blossoms.
Tree hoppers, *Enchenopa binotata*	July	24	Wax work	N. Berwick	Great numbers.
Tree hoppers, *Telamona monticola*	Aug.	1	Woodbine	Bangor	
——— *Diedrocephala versuta*	Sept.	10	Birch sprouts	Orono	Great numbers.
——— *Cosmopepla carnifex*	Aug.	4	Mint	Orono	Great numbers.
——— *Cosmopepla carnifex*	Sept.	12	Potato	Caribou	Common.
——— *Cosmopepla carnifex*	Sept.	15	Poplar	Houlton	Abundant.
——— *Banasa dimidiata*	Sept.	15	Willow	Houlton	Adults exceedingly numerous.
——— *Banasa dimidiata*	Sept.	15	Mountain Ash	Houlton	Larvæ adults numerous in berry clusters.

INSECTS RECEIVED FOR IDENTIFICATION—CONCLUDED.

Name.	Date.		Host.	Locality.	Remarks.
Ichneumon, *Thalessa lunata*	Aug.	22		E. Wilton	Female.
Pear tree slugs, *Eriocampa cerasi*	Sept.	24	Cherry & Plum	Corinna	Bad attack.
Rose slugs, *Monostegia rosæ*	July	18	Rose	Hancock Pt.	Ruined appearance of bushes for four years.
Blackberry seed gall, *Diastrophus cuscutæformis*	May	4	Cultivated blackberry	Gardiner	
Giant American saw fly, *Cimbex americana*	Aug.	1	Elm	S. Berwick	Larva full grown.
Solitary wasp, *Eumenes fraternus*	Aug.	14		Gardiner	"Jug nest" and wasp which emerged.
——— *Limneria guigrardi*	Aug.	29		Augusta	Parasites bred from Œdemasia concinna.
King grasshopper, *Hippiscus tuberculatus*	June	2		Hampden Cor.	Male and female adult.
Sheep bot-fly, *Œstrus ovis*	May	3	Sheep	E. Dixfield	Maggots in nasal passages apparently caused death of sheep.
Maple spot-gall, *Sciara ocellata*	July	2	Maple	Seal Harbor	
Psocids	Aug.	14	Maple and mulberry	N. Parsonfield	On bark in "large droves".
Psocids	Aug.	14	Maple	Alfred	On bark "by thousands".
Psocids	Aug.	18	Maple	Lovell	On bark in great numbers.

FOOD INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of inspection analyses.

The legislature of 1905 enacted a law to regulate the sale and analysis of food. The text of the law and the standards established under it, follow:

CHAPTER 68 OF THE LAWS OF 1905.

An Act to Regulate the Sale and Analysis of Food.

SEC. 1. It shall be unlawful for any person, persons or corporation within this state to manufacture for sale, to sell, or to offer or expose for sale any article of food which is adulterated or misbranded within the meaning of this act.

SEC. 2. The term food, as used in this act, shall include every article used for food or drink by man, horses or cattle.

SEC. 3. For the purpose of this act an article of food shall be considered as adulterated or misbranded:

First. If any substance or substances be mixed or packed with it so as to reduce or lower or injuriously affect its quality or strength.

Second. If any inferior substance or substances be substituted wholly or in part for this article.

Third. If any necessary or valuable constituent of the article be wholly or in part abstracted.

Fourth. If it be in imitation of, or sold under the name of another article.

Fifth. If it be colored, coated, polished or powdered whereby damage is concealed, or if it be made to appear better or of greater value than it is.

Sixth. If it contains poisonous ingredients, or if it contains any antiseptic or preservative not evident or not know to the purchaser.

Seventh. If it consists wholly or in part of a diseased, filthy, decomposed or putrid animal or vegetable substance.

Eighth. If the package or label shall have any statement purporting to name any ingredient or substance as not being contained in the article, which statement shall be untrue in any particular.

Ninth. If the package or label shall bear any statement purporting to name the substance or substances of which the article is made, which statement shall not fully give the names of all substances contained therein.

Tenth. If it be labeled or branded so as to deceive or mislead the purchaser in any particular.

Provided, that any article of food which is adulterated within the meaning of this act, but which does not contain any poisonous or deleterious ingredient, may be manufactured or sold if the same shall be plainly labeled, branded or tagged so as to show the exact character thereof. Provided further, that nothing in this act shall be construed as requiring proprietors, manufacturers or sellers of proprietary foods which contain no unwholesome substances to disclose their trade formulas, except that in the case of baking powders each can or package shall be plainly labeled so as to show the acid salt or salts contained therein.

SEC. 4. The director of the Maine Agricultural Experiment Station shall analyze, or cause to be analyzed, samples of articles of food on sale in Maine, suspected of being adulterated, and at such times and to such extent as said director may determine. And said director, in person or by deputy, shall have free access at all reasonable hours to any place wherein articles of food are offered for sale, and upon tendering the market price of any such article may take from any person, persons or corporations samples for analysis.

SEC. 5. The results of all analyses of articles of food made by said director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the persons from whom the samples were obtained, and the names of the manufacturers thereof. The said director may also adopt or fix standards of purity, quality or strength when such standards are not specified or fixed by law and shall publish them, together with such other information concerning articles of food as may be of public benefit.

SEC. 6. Whoever adulterates or misbrands any article of food as defined in this act, or whoever sells, offers or exposes for

sale any adulterated or misbranded article of food, shall be punished by a fine not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

SEC. 7. Whenever said director becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the commissioner of agriculture, and said commissioner shall prosecute the party or parties thus reported.

SEC. 8. No action shall be maintained in any court in this state on account of any sale or other contract made in violation of this act.

SEC. 9. Sections ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen and seventeen of chapter one hundred and twenty-nine of the revised statutes and all acts or parts of acts inconsistent herewith, are hereby repealed.

SEC. 10. This act shall take effect when approved.

Approved March 15, 1905.

FOOD STANDARDS.

It is from the nature of the case impracticable for a legislature to establish food standards. This is a matter that calls for careful research on the part of experts. It has, therefore, become customary, both in state and national legislation, to place the responsibility of the establishment of standards upon the executive officer. Section 5 of the above cited law empowers the Director of the Maine Agricultural Experiment Station " to adopt or fix standards of purity, quality or strength when such standards are not specified or fixed by law and shall publish them, together with such other information concerning articles of food as may be of public benefit."

The Association of Official Agricultural Chemists of the United States has for some years been preparing definitions and schedules for such standards. The demand for these standards became so urgent as to lead Congress by an act approved June 3, 1902, to authorize the Secretary of Agriculture to co-operate with the above named association for the accomplishment of this work. As a result, although the work is still incomplete, standards for the more important food products have already been fixed and established by the Secretary of Agriculture, acting for the United States.

PRINCIPLES ON WHICH THE STANDARDS ARE BASED.

The general considerations which guided the committee of the Association of Official Agricultural Chemists in preparing the standards for food products are thus stated by them:

1. The standards are expressed in the form of definitions, with or without accompanying specifications of limit in composition.

2. The main classes of food articles are defined before the subordinate classes are considered.

3. The definitions are so framed as to exclude from the articles defined substances not included in the definitions.

4. The definitions include, where possible, those qualities which make the articles described wholesome for human food.

5. A term defined in any of the several schedules has the same meaning wherever else it is used in this report.

6. The names of food products herein defined usually agree with existing American trade or manufacturing usage, but where such usage is not clearly established or where trade names confuse two or more articles for which specific designations are desirable, preference is given to one of the several trade names applied.

7. Standards are based upon data representing materials produced under American conditions and manufactured by American processes or representing such varieties of foreign articles as are chiefly imported for American use.

8. The standards fixed are such that a departure of the articles to which they apply, above the maximum or below the minimum limit prescribed, is evidence that such articles are of inferior or abnormal quality.

9. The limits fixed as standard are not necessarily the extremes authentically recorded for the article in question, because such extremes are commonly due to abnormal conditions of production and are usually accompanied by marks of inferiority or abnormality readily perceived by the producer or manufacturer.

Food Standards Adopted for Maine.

As empowered in Section 5, Chapter 68 of the laws of 1905, the Director of the Maine Agricultural Experiment Station hereby adopts the following standards for purity of food products together with their precedent definitions as the official standards of these food products for the State of Maine. These are the standards above referred to as fixed by the Secretary of Agriculture of the United States.

I. ANIMAL PRODUCTS.

A. Meats and the Principal Meat Products.

a. MEATS.

1. *Meat, flesh,* is any clean, sound, dressed, and properly prepared edible part of animals in good health at the time of slaughter, and if it bears a name descriptive of its kind, composition, or origin, it corresponds thereto. The term "animals," as herein used, includes not only mammals, but fish, fowl, crustaceans, mollusks, and all other animals used as food.

2. *Fresh meat* is meat from animals recently slaughtered and properly cooled until delivered to the consumer.

3. *Cold storage meat* is meat from animals recently slaughtered and preserved by refrigeration until delivered to the consumer.

4. *Salted, pickled,* and *smoked meats* are unmixed meats preserved by salt, sugar, vinegar, spices, or smoke, singly or in combination, whether in bulk or in suitable containers.*

The inner coating of the containers is free from pin holes, blisters, and cracks.

If the tin plate is lacquered, the lacquer completely covers the tinned surface within the container and yields to the contents of the container no lead, antimony, arsenic, zinc or copper or any compounds thereof, or any other poisonous or injurious substance.

b. MANUFACTURED MEATS.

1. *Manufactured meats* are meats not included in paragraphs 2, 3, and 4, which immediately precede, whether simple or mixed, whole or

* Suitable containers for keeping moist food products such as sirups, honey, condensed milk, soups, meat extracts, meats, manufactured meats, and undried fruits and vegetables, and wrappers in contact with food products, contain on their surfaces, in contact with the food product, no lead, antimony, arsenic, zinc or copper or any compounds thereof or any other poisonous or injurious substance. If the containers are made of tin plate they are outside-soldered and the plate in no place contains less than one hundred and thirteen (113) milligrams of tin on a piece five (5) centimeters square or one and eight-tenths (1.8) grains on a piece two (2) inches square.

comminuted, in bulk or in suitable containers,* with or without the addition of salt, sugar, vinegar, spices, smoke, oils, or rendered fat. If they bear names descriptive of kind, composition, or origin, they correspond thereto and when bearing such descriptive names, if force or flavoring meats are used, the kind and quantity thereof are made known.

c. MEAT EXTRACTS, MEAT PEPTONES, ETC.

(Schedule in preparation.)

d. LARD.

1. *Lard* is the rendered fresh fat from hogs in good health at the time of slaughter, is clean, free from rancidity, and contains, necessarily incorporated in the process of rendering, not more than one (1) per cent of substances, other than fatty acids and fat.

2. *Leaf lard* is lard rendered at moderately high temperature from the internal fat of the abdomen of the hog, excluding that adherent to the intestines, and has an iodin number not greater than sixty (60).

3. *Neutral lard* is lard rendered at low temperatures.

B. Milk and Its Products.

a. MILKS.

1. *Milk* * is the fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, and contains not less than twelve (12) per cent of solids, not less than nine (9) per cent of solids not fat, and not less than three (3) per cent of milk fat.

2. *Blended milk* is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

3. *Skim milk* is milk from which a part or all of the cream has been removed and contains not less than nine and one-quarter (9.25) per cent of milk solids.

4. *Pasteurized milk* is milk that has been heated below boiling but sufficiently to kill most of the active organisms present and immediately cooled to 50° Fahr. or lower.

5. *Sterilized milk* is milk that has been heated at the temperature of boiling water or higher for a length of time sufficient to kill all organisms present.

6. *Condensed milk, evaporated milk,* is milk from which a considerable portion of water has been evaporated and contains not less than twenty-eight (28) per cent of milk solids of which not less than twenty-seven and five-tenths (27.5) per cent is milk fat.

7. *Sweetened condensed milk* is milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has

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* These standards are fixed by statute. The standards adopted by the U. S. Secretary of Agriculture are "not less than eight and one-half (8.5) per cent of solids not fat and not less than three and one-quarter (3.25) per cent of milk fat."

been added, and contains not less than twenty-eight (28) per cent of milk solids, of which not less than twenty-seven and five-tenths (27.5) per cent is milk fat.

8. *Condensed skim milk* is skim milk from which a considerable portion of water has been evaporated.

9. *Buttermilk* is the product that remains when butter is removed from milk or cream in the process of churning.

10. *Goat's milk, ewe's milk, et cetera,* are the fresh, clean, lacteal secretions, free from colostrum, obtained by the complete milking of healthy animals other than cows, properly fed and kept, and conform in name to the species of animal from which they are obtained.

b. CREAM.

1. *Cream* is that portion of milk, rich in milk fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force, is fresh and clean and contains not less than eighteen (18) per cent of milk fat.

2. *Evaporated cream, clotted cream,* is cream from which a considerable portion of water has been evaporated.

c. MILK FAT OR BUTTER FAT.

1. *Milk fat, butter fat,* is the fat of milk and has a Reichert-Meissl number not less than twenty-four (24) and a specific gravity not less than 0.905 $\left(\frac{40° \text{ C.}}{40° \text{ C.}}\right)$

d. BUTTER.

1. *Butter* is the clean, non-rancid product made by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt, and contains not less than eighty-two and five-tenths (82.5) per cent of milk fat.

2. *Renovated butter, process butter,* is the product made by melting butter and reworking, wthout the addition or use of chemicals or any substances except milk, cream, or salt, and contains not more than sixteen (16) per cent of water and at least eighty-two and five-tenths (82.5) per cent of milk fat.

e. CHEESE.

1. *Cheese* is the sound, solid, and ripened product made from milk or cream by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments and seasoning, and contains, in the water-free substance, not less than fifty (50) per cent of milk fat.

2. *Skim milk cheese* is the sound, solid, and ripened product, made from skim milk by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments and seasoning.

3. *Goat's milk cheese, ewe's milk cheese, et cetera,* are the sound,

ripened products made from the milks of the animals specified, by coagulating the casein thereof with rennet or lactic acid, with or without the addition of ripening ferments and seasoning.

f. ICE CREAMS.

1. *Ice cream* is a frozen product made from cream and sugar, with or without a natural flavoring, and contains not less than fourteen (14) per cent of milk fat.

2. *Fruit ice cream* is a frozen product made from cream, sugar, and sound, clean, mature fruits, and contains not less than twelve (12) per cent of milk fat.

3. *Nut ice cream* is a frozen product made from cream, sugar, and sound, nonrancid nuts, and contains not less than twelve (12) per cent of milk fat.

g. MISCELLANEOUS MILK PRODUCTS.

1. *Whey* is the product remaining after the removal of fat and casein from milk in the process of cheese-making.

2. *Kumiss* is the product made by the alcoholic fermentation of mare's or cow's milk.

II. VEGETABLE PRODUCTS.

A. GRAIN PRODUCTS.

a. GRAINS AND MEALS.

1. *Grain* is the fully matured, clean, sound, air-dry seed of wheat, maize, rice, oats, rye, buckwheat, barley, sorghum, millet, or spelt.

2. *Meal* is the clean, sound product made by grinding grain.

3. *Flour* is the fine, clean, sound product made by bolting wheat meal and contains not more than thirteen and one-half (13.5) per cent of moisture, not less than one and twenty-five hundredths (1.25) per cent of nitrogen, not more than one (1) per cent of ash, and not more than fifty hundredths (0.50) per cent of fiber.

4. *Graham flour* is unbolted wheat meal.

5. *Gluten flour* is the clean, sound product made from flour by the removal of starch and contains not less than five and six-tenths (5.6) per cent of nitrogen and not more than ten (10) per cent of moisture.

6. *Maize meal, corn meal, Indian corn meal,* is meal made from sound maize grain and contains not more than fourteen (14) per cent of moisture, not less than one and twelve hundredths (1.12) per cent of nitrogen, and not more than one and six-tenths (1.6) per cent of ash.

7. *Rice* is the hulled, or hulled and polished grain of *Oryza sativa.*

8. *Oatmeal* is meal made from hulled oats and contains not more than twelve (12) per cent of moisture, not more than one and five-tenths (1.5) per cent of crude fiber, not less than two and twenty-four hundredths (2.24) per cent of nitrogen, and not more than two and two-tenths (2.2) per cent of ash.

9. *Rye flour* is the fine, clean, sound product made by bolting rye meal and contains not more than thirteen and one-half (13.5) per cent

of moisture, not less than one and thirty-six hundredths (1.36) per cent of nitrogen, and not more than one and twenty-five hundredths (1.25) per cent of ash.

10. *Buckwheat flour* is bolted buckwheat meal and contains not more than twelve (12) per cent of moisture, not less than one and twenty-eight hundredths (1.28) per cent of nitrogen, and not more than one and seventy-five hundredths (1.75) per cent of ash.

B. Fruit and Vegetables.

a. fruit and fruit products.

(Except fruit juices, fresh, sweet, and fermented, and vinegars.)

1. *Fruits* are the clean, sound, edible, fleshy fructifications of plants, distinguished by their sweet, acid, and ethereal flavors.

2. *Dried fruit** is the clean, sound product made by drying mature, properly prepared, fresh fruit in such a way as to take up no harmful substance, and conforms in name to the fruit used in its preparation; *sun-dried fruit* is dried fruit made by drying without the use of artificial means; *evaporated fruit* is dried fruit made by drying with the use of artificial means.

3. *Evaporated apples* are evaporated fruit made from peeled and cored apples, and contain not more than twenty-seven (27) per cent of moisture determined by the usual commercial method of drying for four (4) hours at the temperature of boiling water.

(Standards for other dried fruits are in preparation.)

4. *Canned fruit* is the sound product made by sterilizing clean, sound, properly matured and prepared fresh fruit, by heating, with or without sugar (sucrose) and spices, and keeping in suitable, clean, hermetically sealed containers and conforms in name to the fruit used in its preparation.

5. *Preserve* † is the sound product made from clean, sound, properly matured and prepared fresh fruit and sugar (sucrose) sirup, with or without spices or vinegar, and conforms in name to that of the fruit used, and in its preparation not less than forty-five (45) pounds of fruit are used to each fifty-five (55) pounds of sugar.

6. *Honey preserve* † is preserve in which honey is used in place of sugar (sucrose) sirup.

7. *Glucose preserve* † is preserve in which a glucose product is used in place of sugar (sucrose) sirup.

8. *Jam, marmalade*,† is the sound product made from clean, sound, properly matured and prepared fresh fruit and sugar (sucrose), with or without spices or vinegar, by boiling to a pulpy or semisolid consistence, and conforms in name to the fruit used, and in its preparation not less

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* The subject of sulphurous acid in dried fruits is reserved for consideration in connection with the schedule "Preservatives and Coloring Matters."

† Products made with mixtures of sugar, glucose, and honey, or any two thereof, are reserved for future consideration.

than forty-five (45) pounds of fruit are used to each fifty-five (55) pounds of sugar.

9. *Glucose jam, glucose marmalade,*† is jam in which a glucose product is used in place of sugar (sucrose).

10. *Fruit butter* † is the sound product made from fruit juice and clean, sound, properly matured and prepared fruit, evaporated to a semisolid mass of homogeneous consistence, with or without the addition of sugar and spices or vinegar, and conforms in name to the fruit used in its preparation.

11. *Gluecose fruit butter* † is fruit butter in which a glucose product is used in place of sugar (sucrose).

12. *Jelly* † is the sound, semisolid, gelatinous product made by boiling clean, sound, properly matured and prepared fresh fruit with water, concentrating the expressed and strained juice, to which sugar (sucrose) is added, and conforms in name to the fruit used in its preparation.

13. *Glucose jelly* † is jelly in which a glucose product is used in place of sugar (sucrose).

b. VEGETABLES AND VEGETABLE PRODUCTS.

1. *Vegetables* are the succulent, clean, sound, edible parts of herbaceous plants used for culinary purposes.

2. *Dried vegetables* are the clean, sound products made by drying properly matured and prepared vegetables in such a way as to take up no harmful substance, and conform in name to the vegetables used in their preparation; *sun-dried vegetables* are dried vegetables made by drying without the use of artificial means; *evaporated vegetables* are dried vegetables made by drying with the use of artificial means.

3. *Canned vegetables* are sound, properly matured and prepared fresh vegetables, with or without salt, sterilized by heat, with or without previous cooking in vessels from which they take up no metallic substance, kept in suitable, clean, hermetically sealed containers, are sound and conform in name to the vegetables used in their preparation.

4. *Pickles* are clean, sound, immature cucumbers, properly prepared, without taking up any metallic compound other than salt, and preserved in any kind of vinegar, with or without spices; *pickled onions, pickled beets, pickled beans,* and other pickled vegetables are vegetables prepared as described above, and conform in name to the vegetables used.

5. *Salt pickles* are clean, sound, immature cucumbers, preserved in a solution of common salt, with or without spices.

6. *Sweet pickles* are pickled cucumbers or other vegetables in the preparation of which sugar (sucrose) is used.

7. *Sauerkraut* is clean, sound, properly prepared cabbage, mixed with salt, and subjected to fermentation.

8. *Catchup* (*ketchup, catsup*) is the clean, sound product made from the properly prepared pulp of clean, sound, fresh, ripe tomatoes, with

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† Products made with mixtures of sugar, glucose, and honey, or any two thereof, are reserved for future consideration.

spices and with or without sugar and vinegar; *mushroom catchup, walnut catchup, et cetera,* are catchups made as above described, and conform in name to the substances used in their preparation.

C. Sugars and Related Substances.

a. sugar and sugar products.

Sugars.

1. *Sugar* is the product chemically known as sucrose (saccharose) chiefly obtained from sugar cane, sugar beets, sorghum, maple, and palm.

2. *Granulated, loaf, cut, milled,* and *powdered sugars* are different forms of sugar and contain at least ninety-nine and five-tenths (99.5) per cent of sucrose.

3. *Maple sugar* is the solid product resulting from the evaporation of maple sap, and contains, in the water-free substance, not less than sixty-five one-hundredths (0.65) per cent of maple sugar ash.

4. *Massecuite, melada, mush sugar,* and *concrete* are products made by evaporating the purified juice of a sugar-producing plant, or a solution of sugar, to a solid or semisolid consistence, and in which the sugar chiefly exists in a crystalline state.

Molasses and Refiners' Sirup.

1. *Molasses* is the product left after separating the sugar from massecuite, melada, mush sugar, or concrete, and contains not more than twenty-five (25) per cent of water and not more than five (5) per cent of ash.

2. *Refiners' sirup, treacle,* is the residual liquid product obtained in the process of refining raw sugars and contains not more than twenty-five (25) per cent of water and not more than eight (8) per cent of ash.

Sirups.

1. *Sirup* is the sound product made by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar.

2. *Sugar-cane sirup* is sirup made by the evaporation of the juice of the sugar-cane or by the solution of sugar-cane concrete, and contains not more than thirty (30) per cent of water and not more than two and five-tenths (2.5) per cent of ash.

3. *Sorghum sirup* is sirup made by the evaporation of sorghum juice or by the solution of sorghum concrete, and contains not more than thirty (30) per cent of water and not more than two and five-tenths (2.5) per cent of ash.

4. *Maple sirup* is sirup made by the evaporation of maple sap or by the solution of maple concrete, and contains not more than thirty-two (32) per cent of water and not less than forty-five hundredths (0.45) per cent of maple sirup ash.

5. *Sugar sirup* is the product made by dissolving sugar to the consistence of a sirup and contains not more than thirty-five (35) per cent of water.

b. GLUCOSE PRODUCTS.

1. *Starch sugar* is the solid product made by hydrolyzing starch or a starch-containing substance until the greater part of the starch is converted into dextrose. Starch sugar appears in commerce in two forms, anhydrous starch sugar and hydrous starch sugar. The former, crystallized without water or crystallization, contains not less than ninety-five (95) per cent of dextrose and not more than eight-tenths (0.8) per cent of ash. The latter, crystallized with water of crystallization, is of two varieties—70 sugar, also known as brewers' sugar, contains not less than seventy (70) per cent of dextrose and not more than eight-tenths (0.8) per cent of ash; 80 sugar, climax or acme sugar, contains not less than eighty (80) per cent of dextrose and not more than one and one-half (1.5) per cent of ash.

The ash of all these products consists almost entirely of chlorids and sulphates.

2. *Glucose, mixing glucose, confectioners' glucose,* is a thick, sirupy, colorless product made by incompletely hydrolyzing starch, or a starch-containing substance, and decolorizing and evaporating the product. It varies in density from forty-one (41) to forty-five (45) degrees Baumé at a temperature of 100° Fahr. (37.7° C.), and conforms in density, within these limits, to the degree Baumé it is claimed to show, and for a density of forty-one (41) degrees Baumé contains not more than twenty-one (21) per cent and for a density of forty-five (45) degrees not more than fourteen (14) per cent of water. It contains on a basis of forty-one (41) degrees Baumé not more than one (1) per cent of ash, consisting chiefly of chlorids and sulphates.

c. CANDY.

1. *Candy* is a product made from a saccharine substance or substances with or without the addition of harmless coloring, flavoring, or filling materials and contains no terra alba, barytes, talc, chrome yellow, or other mineral substances, or poisonous colors or flavors, or other ingredients deleterious or detrimental to health, or any vinous, malt, or spiritous liquor or compound, or narcotic drug.

d. HONEY.

1. *Honey* is the nectar and saccharine exudations of plants gathered, modified, and stored in the comb by honey bees (*Apis mellifica* and *A. dorsata*); is lævo-rotatory, contains not more than twenty-five (25) per cent of water, not more than twenty-five hundredths (0.25) per cent of ash, and not more than eight (8) per cent of sucrose.

2. *Comb honey* is honey contained in the cells of comb.

3. *Extracted honey* is honey which has been separated from the uncrushed comb by centrifugal force or gravity.

4. *Strained honey* is honey removed from the crushed comb by straining or other means.

D. Condiments (except Vinegar and Salt).

a. SPICES.

1. *Spices* are aromatic vegetable substances used for the seasoning of food and from which no portion of any volatile oil or other flavoring principle has been removed and which are clean, sound, and true to name.

2. *Allspice, pimento,* is the dried fruit of the *Pimenta pimenta* (L.) Karst., and contains not less than eight (8) per cent of quercitannic acid *; not more than six (6) per cent of total ash, not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than twenty-five (25) per cent of crude fiber.

3. *Anise* is the fruit of the *Pimpinella anisum* L.

4. *Bay leaf* is the dried leaf of *Laurus nobilis* L.

5. *Capers* are the flower buds of *Capparis spinosa* L.

6. *Caraway* is the fruit of *Carum carvi* L.

Cayenne and Red Peppers.

7. *Red pepper* is the red, dried, ripe fruit of any species of *Capsicum.*

8. *Cayenne papper, cayenne,* is the dried ripe fruit of *Capsicum frutescens* L., *Capsicum baccatum* L., or some other small-fruited species of *Capsicum,* and contains not less than fifteen (15) per cent of non-volatile ether extract; not more than six and five-tenths (6.5) per cent of total ash; not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid; not more than one and five-tenths (1.5) per cent of starch, and not more than twenty-eight (28) per cent of crude fiber.

9. *Paprika* is the dried ripe fruit of *Capsicum annuum* L., or some other large-fruited species of *Capsicum,* excluding seeds and stems.

10. *Celery seed* is the dried fruit of *Apium graveolens* L.

11. *Cinnamon* is the dried bark of any species of the genus *Cinnamomum* from which the outer layers may or may not have been removed.

12. *True cinnamon* is the dried inner bark of *Cinnamomum zeylanicum* Breyne.

13. *Cassia* is the dried bark of various species of *Cinnamomum,* other than *Cinnamomum zeylanicum,* from which the outer layers may or may not have been removed.

14. *Cassia buds* are the dried immature fruit of species of *Cinnamomum.*

15. *Ground cinnamon, ground cassia,* is a powder consisting of cinnamon, cassia, or cassia buds, or a mixture of these spices, and contains not more than six (6) per cent of total ash and not more than two (2) per cent of sand.

16. *Cloves* are the dried flower buds of *Caryophyllus aromaticus* L., which contain not more than five (5) per cent of clove stems; not less than ten (10) per cent of volatile ether extract; not less than twelve

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* Calculated from the total oxygen absorbed by the aqueous extract.

(12) per cent of quercitannic acid *; not more than eight (8) per cent of total ash; not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

17. *Coriander* is the dried fruit of *Coriandum sativum* L.

18. *Cumin seed* is the fruit of *Cuminum cyminum* L.

19. *Dill seed* is the fruit of *Anethum graveolens* L.

20. *Fennel* is the fruit of *Foeniculum foeniculum* (L.) Karst.

21. *Ginger* is the washed and dried or decorticated and dried rhizome of *Zinziber zingiber* (L.) Karst., and contains not less than forty-two (42) per cent of starch; not more than eight (8) per cent of crude fiber, not more than six (6) per cent of total ash, not more than one (1) per cent of lime, and not more than three (3) per cent of ash insoluble in hydrochloric acid.

22. *Limed ginger, bleached ginger,* is whole ginger coated with carbonate of lime and contains not more than ten (10) per cent of ash, not more than four (4) per cent of carbonate of lime, and conforms in other respects to the standard for ginger.

23. *Horse-radish* is the root of *Roripa armoracia* (L.) Hitchcock, either by itself or ground and mixed with vinegar.

24. *Mace* is the dried arillus of *Myristica fragrans* Houttuyn, and contains not less than twenty (20) nor more than thirty (30) per cent of nonvolatile ether extract, not more than three (3) per cent of total ash, and not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

25. *Macassar mace, Papua mace,* is the dried arillus of *Myristica argentea* Warb.

26. *Bombay mace* is the dried arillus of *Myristica malabarica* Lamarck.

27. *Marjoram* is the leaf, flower and branch of *Majorana majorana* (L.) Karst.

28. *Mustard seed* is the seed of *Sinapis alba* L. (white mustard), *Brassica nigra* (L.) Koch (black mustard), or *Brassica juncea* (L.) Cosson (black or brown mustard).

29. *Ground mustard* is a powder made from mustard seed, with or without the removal of the hulls and a portion of the fixed oil, and contains not more than two and five-tenths (2.5) per cent of starch and not more than eight (8) per cent of total ash.

30. *Prepared mustard, German mustard, French mustard, mustard paste,* is a paste composed of a mixture of ground mustard seed or mustard flour with salt, spices and vinegar, and, calculated free from water, fat and salt, contains not more than twenty-four (24) per cent of carbohydrates calculated as starch, determined according to the official methods, not more than twelve (12) per cent of crude fiber nor less than thirty-five (35) per cent of protein, derived solely from the materials named.

31. *Nutmeg* is the dried seed of the *Myristica fragrans* Houttuyn, deprived of its testa, with or without a thin coating of lime, and contains not less than twenty-five (25) per cent of nonvolatile ether extract, not more than five (5) per cent of total ash, not more than five-tenths

(0.5) per cent of ash insoluble in hydrochloric acid, and not more than ten (10) per cent of crude fiber.

32. *Macassar nutmeg, Papua nutmeg, male nutmeg, long nutmeg,* is the dried seed of *Myristica argentea* Warb. deprived of its testa.

Pepper.

33. *Black pepper* is the dried immature berry of *Piper nigrum* L. and contains not less than six (6) per cent of nonvolatile ether extract, not less than twenty-five (25) per cent of starch, not more than seven (7) per cent of total ash, not more than two (2) per cent of ash insoluble in hydrochloric acid, and not more than fifteen (15) per cent of crude fiber. One hundred parts of the nonvolatile ether extract contain not less than three and one-quarter (3.25) parts of nitrogen. *Ground black pepper* is the product made by grinding the entire berry and contains the several parts of the berry in their normal proportions.

34. *Long pepper* is the dried fruit of *Piper longum* L.

35. *White pepper* is the dried mature berry of *Piper nigrum* L. from which the outer coating or the outer and inner coatings have been removed and contains not less than six (6) per cent of nonvolatile ether extract, not less than fifty (50) per cent of starch, not more than four (4) per cent of total ash, not more than five-tenths (0.5) per cent of ash insoluble in hydrochloric acid, and not more than five (5) per cent of crude fiber. One hundred parts of the nonvolatile ether extract contain not less than four (4) parts of nitrogen.

36. *Saffron* is the dried stigma of *Crocus sativus* L.

37. *Sage* is the leaf of *Salvia officinalis* L.

38. *Savory, summer savory,* is the leaf, blossom, and branch of *Satureja hortensis* L.

39. *Thyme* is the leaf and tip of blooming branches of *Thymus Vulgaris* L.

b. FLAVORING EXTRACTS.

1. *A flavoring extract* * is a solution in ethyl alcohol of proper strength of the sapid and odorous principles derived from an aromatic plant, or parts of the plant, with or without its coloring matter, and conforms in name to the plant used in its preparation.

2. *Almond extract* is the flavoring extract prepared from oil of bitter almonds, free from hydrocyanic acid, and contains not less than one (1) per cent by volume of oil of bitter almonds.

2a. *Oil of bitter almonds,* commercial, is the volatile oil obtained from the seed of the bitter almond (*Amygdalus communis* L.), the apricot (*Prunus armeniaca* L.), or the peach (*Amygdalus persica* L.).

3. *Anise extract* is the flavoring extract prepared from oil of anise, and contains not less than three (3) per cent by volume of oil of anise.

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* The flavoring extracts herein described are intended solely for food purposes and are not to be confounded with similar preparations described in the Pharmacopœia for medicinal purposes.

3a. *Oil of anise* is the volatile oil obtained from the anise seed.

4. *Celery seed extract* is the flavoring extract prepared from celery seed or the oil of celery seed, or both, and contains not less than three-tenths (0.3) per cent by volume of oil of celery seed.

4a. *Oil of celery seed* is the volatile oil obtained from celery seed.

5. *Cassia extract* is the flavoring extract prepared from oil of cassia and contains not less than two (2) per cent by volume of oil of cassia.

5a. *Oil of cassia* is the lead-free volatile oil obtained from the leaves or bark of *Cinnamomum cassia* Bl., and contains not less than seventy-five (75) per cent by weight of cinnamic aldehyde.

6. *Cinnamon extract* is the flavoring extract prepared from oil of cinnamon, and contains not less than two (2) per cent by volume of oil of cinnamon.

6a. *Oil of cinnamon* is the lead-free volatile oil obtained from the bark of the Ceylon cinnamon (*Cinnamomum zeylanicum* Breyne), and contains not less than sixty-five (65) per cent by weight of cinnamic aldehyde and not more than ten (10) per cent by weight of eugenol.

7. *Clove extract* is the flavoring extract prepared from oil of cloves, and contains not less than two (2) per cent by volume of oil of cloves.

7a. *Oil of cloves* is the lead-free, volatile oil obtained from cloves.

8. *Ginger extract* is the flavoring extract prepared from ginger and contains in each one hundred (100) cubic centimeters, the alcohol-soluble matters from not less than twenty (20) grams of ginger.

9. *Lemon extract* is the flavoring extract prepared from oil of lemon, or from lemon peel, or both, and contains not less than five (5) per cent by volume of oil of lemon.

9a. *Oil of lemon* is the volatile oil obtained by expression or alcoholic solution, from the fresh peel of the lemon (*Citrus limonum* L.), has an optical rotation (25° C.) of not less than +60° in a 100-millimeter tube, and contains not less than four (4) per cent by weight of citral.

10. *Terpeneless extract of lemon* is the flavoring extract prepared by shaking oil of lemon with dilute alcohol, or by dissolving terpeneless oil of lemon in dilute alcohol, and contains not less than two-tenths (0.2) per cent by weight of citral derived from oil of lemon.

10a. *Terpeneless oil of lemon* is oil of lemon from which all or nearly all of the terpenes have been removed.

11. *Nutmeg extract* is the flavoring extract prepared from oil of nutmeg, and contains not less than two (2) per cent by volume of oil of nutmeg.

11a. *Oil of nutmeg* is the volatile oil obtained from nutmegs.

12. *Orange extract* is the flavoring extract prepared from oil of orange, or from orange peel, or both, and contains not less than five (5) per cent by volume of oil of orange.

12a. *Oil of orange* is the volatile oil obtained, by expression or alcoholic solution, from the fresh peel of the orange (*Citrus aurantium* L.) and has an optical rotation (25° C.) of not less than +95° in a 100-millimeter tube.

13. *Terpeneless extract of orange* is the flavoring extract prepared by shaking oil of orange with dilute alcohol, or by dissolving terpeneless oil of orange in dilute alcohol, and corresponds in flavoring strength to orange extract.

13*a*. *Terpeneless oil of orange* is oil of orange from which all or nearly all of the terpenes have been removed.

14. *Peppermint extract* is the flavoring extract prepared from oil of peppermint, or from peppermint, or both, and contains not less than three (3) per cent by volume of oil of peppermint.

14*a*. *Peppermint* is the leaves and flowering tops of *Mentha piperita* L.

14*b*. *Oil of peppermint* is the volatile oil obtained from peppermint and contains not less than fifty (50) per cent by weight of menthol.

15. *Rose extract* is the flavoring extract prepared from otto of roses, with or without red rose petals, and contains not less than four-tenths (0.4) per cent by volume of otto of roses.

15*a*. *Otto of roses* is the volatile oil obtained from the petals of *Rosa damascena* Mill., *R. centifolia* L., or *R. moschata* Herrm.

16. *Savory extract* is the flavoring extract prepared from oil of savory, or from savory, or both, and contains not less than thirty-five hundredths (0.35) per cent by volume of oil of savory.

16*a*. *Oil of savory* is the volatile oil obtained from savory.

17. *Spearmint extract* is the flavoring extract prepared from oil of spearmint, or from spearmint, or both, and contains not less than three (3) per cent by volume of oil of spearmint.

17*a*. *Spearmint* is the leaves and flowering tops of *Mentha spicata* L.

17*b*. *Oil of spearmint* is the volatile oil obtained from spearmint.

18. *Star anise extract* is the flavoring extract prepared from oil of star anise, and contains not less than three (3) per cent by volume of oil of star anise.

18*a*. *Oil of star anise* is the volatile oil distilled from the fruit of the star anise (*Illicium verum* Hook).

19. *Sweet basil extract* is the flavoring extract prepared from oil of sweet basil, or from sweet basil, or both, and contains not less than one-tenth (0.1) per cent by volume of oil of sweet basil.

19*a*. *Sweet basil, basil,* is the leaves and tops of *Ocymum basilicum* L.

19*b*. *Oil of sweet basil* is the volatile oil obtained from basil.

20. *Sweet marjoram extract, marjoram extract,* is the flavoring extract prepared from the oil of marjoram, or from marjoram, or both, and contains not less than one (1) per cent by volume of oil of marjoram.

20*a*. *Oil of marjoram* is the volatile oil obtained from marjoram.

21. *Thyme extract* is the flavoring extract prepared from oil of thyme, or from thyme, or both, and contains not less than two-tenths (0.2) per cent by volume of oil of thyme.

21*a*. *Oil of thyme* is the volatile oil obtained from thyme.

22. *Tonka extract* is the flavoring extract prepared from tonka bean, with or without sugar or glycerin, and contains not less than one-tenth (0.1) per cent by weight of coumarin extracted from the tonka bean,

together with a corresponding proportion of the other soluble matters thereof.

22a. *Tonka bean* is the seed of *Coumarouna odorata* Aublet (*Dipteryx odorata* (Aubl.) Willd.).

23. *Vanilla extract* is the flavoring extract prepared from vanilla bean, with or without sugar or glycerin, and contains in one hundred (100) cubic centimeters the soluble matters from not less than ten (10) grams of the vanilla bean.

23a. *Vanilla bean* is the dried, cured fruit of *Vanilla planifolia* Andrews.

24. *Wintergreen extract* is the flavoring extract prepared from oil of wintergreen, and contains not less than three (3) per cent by volume of oil of wintergreen.

24a. *Oil of wintergreen* is the volatile oil distilled from the leaves of the *Gaultheria procumbens* L.

C. EDIBLE VEGETABLE OILS AND FATS.

1. *Olive oil* is the oil obtained from the sound, mature fruit of the cultivated olive tree (*Olea europoea* L.) and subjected to the usual refining processes; is free from rancidity; has a refractive index (25° C.) not less than one and forty-six hundred and sixty ten-thousandths (1.4660) and not exceeding one and forty-six hundred and eighty ten-thousandths (1.4680); and an iodin number not less than seventy-nine (79) and not exceeding ninety (90).

2. *Virgin olive oil* is olive oil obtained from the first pressing of carefully selected, hand-picked olives.

3. *Cotton-seed oil* is the oil obtained from the seeds of cotton plants (*Gossypium hirsutum* L., *G. barbadense* L., or *G. herbaceum* L.) and subjected to the usual refining processes; is free from rancidity; has a refractive index (25° C.) not less than one and forty-seven hundred ten-thousandths (1.4700) and not exceeding one and forty-seven hundred and twenty-five ten-thousandths (1.4725); and an iodin number not less than one hundred and four (104) and not exceeding one hundred and ten (110).

4. *"Winter-yellow" cotton-seed oil* is expressed cotton-seed oil from which a portion of the stearin has been separated by chilling and pressure, and has an iodin number not less than one hundred and ten (110) and not exceeding one hundred and sixteen (116).

5. *Peanut oil, arachis oil, earthnut oil,* is the oil obtained from the peanut (*Arachis hypogæa* L.) and subjected to the usual refining processes; is free from rancidity; has a refractive index (25° C.) not less than one and forty-six hundred and ninety ten-thousandths (1.4690) and not exceeding one and forty-seven hundred and seven ten-thousandths (1.4707); and an iodin number not less than eighty-seven (87) and not exceeding one hundred (100).

6. *"Cold-drawn" peanut oil** is a peanut oil obtained by pressure without heating.

7. *Sesame oil, gingili oil, teel oil,* is the oil obtained from the seeds of the sesame plants (*Sesamum orientale* L. and *S. radiatum* Schum. and Thonn.) and subjected to the usual refining processes; is free from rancidity; has a refractive index (25° C.) not less than one and forty-seven hundred and four ten-thousandths (1.4704) and not exceeding one and forty-seven hundred and seventeen ten-thousandths (1.4717); and an iodin number not less than one hundred and three (103) and not exceeding one hundred and twelve (112).

8. *"Cold-drawn" sesame oil** is sesame oil obtained by pressure without heating.

9. *Poppy-seed oil** is the oil obtained from the seed of the poppy (*Papaver somniferum* L.) subjected to the usual refining processes and free from rancidity.

10. *White poppy-seed oil, "cold-drawn" poppy-seed oil,** is poppy-seed oil of the first pressing without heating.

11. *Coconut oil** is the oil obtained from the kernels of the coconut (*Cocos nucifera* L.) and subjected to the usual refining processes and free from rancidity.

12. *Cochin oil* is coconut oil prepared in Cochin (Malabar).

13. *Ceylon oil* is coconut oil prepared in Ceylon.

14. *Copra oil* is coconut oil prepared from copra, the dried kernels of the coconut.

15. *Rape-seed oil, colza oil,** is the oil obtained from the seeds of the rape plant (*Brassica napus* L.) and subjected to the usual refining processes and free from rancidity.

16. *"Cold-drawn" rape-seed oil** is rape-seed oil obtained by the first pressing without heating.

17. *Sunflower oil** is the oil obtained from the seeds of the sunflower (*Helianthus annuus* L.) and subjected to the usual refining processes and free from rancidity.

18. *"Cold-drawn" sunflower oil** is sunflower oil obtained by the first pressing without heating.

19. *Maize oil, corn oil,** is the oil obtained from the germ of the maize (*Zea mays* L.) and subjected to the usual refining processes and free from rancidity.

20. *Cocoa butter, cacao butter,* is the fat obtained from roasted, sound cocoa beans, and subjected to the usual refining processes; is free from rancidity; has a refractive index (40° C.) not less than one and forty-five hundred and sixty-six ten-thousandths (1.4566) and not exceeding one and forty-five hundred and ninety-eight ten-thousandths (1.4598); an iodin number not less than thirty-three (33) and not exceeding thirty-eight (38); and a melting-point not lower than 30° C. nor higher than 35° C.

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* The fixing of limits for chemical and physical properties is reserved for future consideration.

21. *Cotton-seed oil stearin* is the solid product made by chilling cotton-seed oil and separating the solid portion by filtration, with or without pressure, and having an iodin number not less than eighty-five (85) and not more than one hundred (100).

E. Tea, Coffee, and Cocoa Products.

a. TEA.

1. *Tea* is the leaves and leaf buds of different species of *Thea*, prepared by the usual trade processes of fermenting, drying, and firing; meets the provisions of the act of Congress approved March 2, 1897, and the regulations made in conformity therewith (Treasury Department Circular 16, February 6, 1905); conforms in variety and place of production to the name it bears; and contains not less than four (4) nor more than seven (7) per cent of ash.

b. COFFEE.

1. *Coffee* is the seed of *Coffea arabica* L. or *Coffea liberica* Bull., freed from all but a small portion of its spermoderm, and conforms in variety and place of production to the name it bears.

2. *Roasted coffee* is coffee which by the action of heat has become brown and developed its characteristic aroma, and contains not less than ten (10) per cent of fat and not less than three (3) per cent of ash.

c. COCOA AND COCOA PRODUCTS.

1. *Cocoa beans* are the seeds of the cacao tree, *Theobroma cacao* L.

2. *Cocoa nibs, cracked cocoa,* is the roasted, broken cocoa bean freed from its shell or husk.

3. *Chocolate, plain chocolate, bitter chocolate, chocolate liquor, bitter chocolate coatings,* is the solid or plastic mass obtained by grinding cocoa nibs without the removal of fat or other constituents except the germ, and contains not more than three (3) per cent of ash insoluble in water, three and fifty hundredths (3.50) per cent of crude fiber, and nine (9) per cent of starch, and not less than forty-five (45) per cent of cocoa fat.

4. *Sweet chocolate, sweet chocolate coatings,* is chocolate mixed with sugar (sucrose), with or without the addition of cocoa butter, spices, or other flavoring materials, and contains in the sugar- and fat-free residue no higher percentage of either ash, fiber, or starch than is found in the sugar- and fat-free residue of chocolate.

5. *Cocoa, powdered cocoa,* is cocoa nibs, with or without the germ, deprived of a portion of its fat and finely pulverized, and contains percentages of ash, crude fiber, and starch corresponding to those in chocolate after correction for fat removed.

6. *Sweet cocoa, sweetened cocoa,* is cocoa mixed with sugar (sucrose), and contains not more than sixty (60) per cent of sugar (sucrose), and in the sugar- and fat-free residue no higher percentage of either ash, crude fiber, or starch than is found in the sugar- and fat-free residue of chocolate.

F. Beverages.

a. FRUIT JUICES—FRESH, SWEET, AND FERMENTED.

1. *Fresh and 2. Sweet.*

(Schedules in preparation.)

3. *Fermented Fruit Juices.*

(Sale illegal in Maine.)

b. MEAD, ROOT BEER, ETC.

(Schedule in preparation.)

c. MALT LIQUORS.

(Sale illegal in Maine.)

d. SPIRITUOUS LIQUORS.

(Sale illegal in Maine.)

e. CARBONATED WATERS, ETC.

(Schedule in preparation.)

G. Vinegar.

1. *Vinegar, cider vinegar, apple vinegar,* is the product made by the alcoholic and subsequent acetous fermentations of the juice of apples, is lævo-rotatory, and contains not less than four (4) grams of acetic acid, not less than one and six-tenths (1.6) grams of apple solids, of which not more than fifty (50) per cent are reducing sugars, and not less than twenty-five hundredths (0.25) gram of apple ash in one hundred (100) cubic centimeters (20° C.); and the water-soluble ash from one hundred (100) cubic centimeters (20° C.) of the vinegar contains not less than ten (10) milligrams of phosphoric acid (P_2O_5), and requires not less than thirty (30) cubic centimeters of decinormal acid to neutralize its alkalinity.

2. *Wine vinegar, grape vinegar,* is the product made by the alcoholic and subsequent acetous fermentations of the juice of grapes and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grams of acetic acid, not less than one (1.0) gram of grape solids, and not less than thirteen hundredths (0.13) gram of grape ash.

3. *Malt vinegar* is the product made by the alcoholic and subsequent acetous fermentations, without distillation, of an infusion of barley malt or cereals whose starch has been converted by malt, is dextro-rotatory, and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grams of acetic acid, not less than two (2) grams of solids, and not less than two-tenths (0.2) gram of ash; and the water-soluble ash from one hundred (100) cubic centimeters (20° C.) of the vinegar contains not less than nine (9) milligrams of phosphoric acid (P_2O_5), and requires not less than four (4) cubic centimeters of decinormal acid to neutralize its alkalinity.

4. *Sugar vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of sugar, sirup, molasses, or refiners'

sirup, and contains, in one hundred (100) cubic centimeters (20° C.) not less than four (4) grams of acetic acid.

5. *Glucose vinegar* is the product made by the alcoholic and subsequent acetous fermentations of solutions of starch sugar or glucose, is dextro-rotatory, and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grams of acetic acid.

6. *Spirit vinegar, distilled vinegar, grain vinegar,* is the product made by the acetous fermentation of dilute distilled alcohol, and contains, in one hundred (100) cubic centimeters (20° C.), not less than four (4) grams of acetic acid.

III. SALT.

1. *Table salt, dairy salt,* is fine-grained crystalline salt containing on a water-free basis, not more than one and four-tenths (1.4) per cent of calcium sulphate ($CaSO_4$), nor more than five-tenths (0.5) per cent of calcium and magnesium chlorids ($CaCl_2$ and $MgCl_2$), nor more than one-tenth (0.1) per cent of matters insoluble in water.

IV. PRESERVATIVES AND COLORING MATTERS.

(Schedules in preparation.)

National Pure Food Law.

The National Pure Food Law entitled "The Act for preventing the manufacture, sale, or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines, and liquors, and for regulating traffic therein, and for other purposes," was approved June 30, 1906, and takes effect January 1, 1907. The law, so far as it relates to foods, has practically the same requirements as the Maine Pure Food Law. The Secretary of Agriculture is the executive officer of the National Pure Food Law. The food standards * are the same as those herewith adopted. While the National Law only regulates interstate commerce and hence does not apply to materials produced within the State, the rules and regulations † prescribed by the Secretary of Agriculture will be recognized in all respects in the execution of the Maine Pure Food Law. There will therefore be only one set of standards and rules regulating the sale of food in Maine. Any article of food sold in conformity to the National Law will be held to be in conformity to the State Law.

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* Circular 19, Office of the Secretary, U. S. Department of Agriculture.

† Circular 21 of the Secretary of Agriculture, U. S. Department of Agriculture.

FOOD INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of inspection analysis.

The law regulating the sale and analysis of foods, enacted by the legislature of Maine in 1905, contemplates two things; the proper and truthful branding of all articles of food, and the exclusion from the markets of deleterious food materials. The law does not seek to prevent the sale of any article of wholesome food, but in case a food material is other than it appears to be, it "shall be plainly labeled, branded or tagged so as to show the exact character thereof." Bulletin 135 of this Station contains the full text of the law and food standards so far as they have been fixed for Maine. Copies of this bulletin may be had on application to the Station.

BAKING POWDERS.

There are practically three classes of baking powders on the market, differing chiefly in the source of the acid:—

Tartrate powders, in which the acid is either cream of tartar (by-tartrate of soda) or tartaric acid.

Phosphate powders, in which calcium or sodium acid phosphate is the acid constituent.

Alum powders, in which the acid constituent is the sulphate of aluminum as it occurs in the various alums.

There are of course many complex baking powders on the market which are made up of mixtures of two or more of the three classes above named. Of these mixtures, phosphate-alum powders are the most common. Indeed, phosphate-alum powders are far more common than straight alum powders.

Whether the acid principle be tartaric acid, calcium phosphate or aluminum sulphate, there is always a residual product which is undesirable as a food. Cream of tartar powders leave a residue of Rochelle salt, the active principle of Seidlitz powders; tartaric acid powders leave a residue of sodium tartrate; phosphate powders leave a residue of sodium and calcium phosphates; and alum powders leave a residue of ammonium, potassium or sodium sulphate, in accordance with the kind of alum

used. The residues of the phosphate-alum powders differ somewhat from those of either alum or phosphate powders and vary with the proportion of the different acid constituents used. When the ingredients are properly proportioned in the baking powder, neither alum or alum phosphate powders leave any considerable amount of alum in the resulting bread or cake.

There is a great dispute as to which of these different residues are the least objectionable. The food law of this State does not attempt to in any way answer the question as to which is best. They are all put on the same footing of correctly stating the source of the acid constituent. A baking powder is adulterated under the law only when the label does not truthfully name the kind of acid salt it contains; when it is falsely labeled in any particular; or when it contains useless, inert foreign matter, mineral or otherwise.

The per cent of available carbonic acid gas furnished by the different classes of baking powders is, according to Wiley,* as follows:

Cream of tartar baking powder, 12 per cent available carbonic acid gas.

Phosphate baking powder, 13.0 per cent available carbonic acid gas.

Alum baking powder, 8.1 per cent available carbonic acid gas.

Phosphate-alum powder, 10.4 per cent available carbonic gas.

The alum powders would require a half more than the tartrate or phosphate powders to produce the same leavening effect. There are however very few straight alum powders on the market. Because of the greater leavening effect of the mixed powders and the supposed less harmful residues, nearly all the alum now used is in the phosphate-alum powders.

The samples here collected and reported upon have not been tested for strength, but merely for correctness of labeling. Many of the less common brands were found by correspondence with the manufacturers to be three or more years old. Naturally such powders would not be nearly as effective leavening agents as when they were fresher.

A description of the brands collected, the cost of the powders, and comments follow.

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*The figures are quoted from Bul. 13 of Div. of Chemistry, U. S. Dept. of Agr.

The brand, maker, dealer, cost, and character of baking powders examined.

CREAM OF TARTAR AND TARTARIC ACID POWDERS.

7464. *Cleveland Superior Baking Powder,* made by Cleveland Baking Powder Company, New York. Purchased from John Dingley Co., Auburn. In half pound tin. Price per can 25 cents. Cost per ounce 3.2 cents. Guaranteed cream of tartar and bicarbonate of soda. The acid salt is correctly named.

7467. *Cream Baking Powder,* made by Price Baking Powder Co., N. Y. and Chicago. Purchased from Merrill & Crowell, Lewiston. In half pound tin. Price per can 25 cents. Cost per ounce 3.8 cents. Guaranteed cream of tartar; no alum, ammonia, lime or other adulterants. The acid salt is correctly named.

7475. *John Alden Baking Powder,* made by W. L. Wilson & Co., Portland. Purchased from manufacturer. In one pound tin. Price per can 45 cents. Cost per ounce 3.0 cents. Guaranteed cream of tartar, tartaric acid, and bicarbonate of soda. The acid salts are correctly named.

7476. *King Arthur Baking Powder,* made by Neally & Miller, Lewiston. Purchased from manufacturer. In half pound tin. Guaranteed cream of tartar, tartaric acid and bicarbonate of soda. The acid salts are correctly named.

7471. *Plume Baking Powder,* made by Plume Baking Powder Co., Malden, Mass. Purchased from W. L. Wilson Co., Portland. In pound tin. Price per can 40 cents. Cost per ounce 3.7 cents. Guaranteed cream of tartar starch and bicarbonate of soda. The acid salt is correctly named.

7470. *Schilling's Best Baking Powder,* made by A. Schilling & Co., San Francisco, Cal. Purchased from F. H. Verrill, Portland. In pound tin. Price per pound 45 cents. Cost per ounce 2.7 cents. The acid salt was not named on the label. The manufacturer stated that these were old goods and that all goods now sent out are labeled cream of tartar baking powder. Acid salt is as claimed.

7474. *Shaw's Baking Powder,* made by Geo. C. Shaw & Co., Portland. Purchased from manufacturer. In one pound tin. Price per can 43 cents. Cost per ounce 2.8 cents. Guaranteed a high grade cream of tartar baking powder, free from starch, alum phosphate, lime sulphate or chlorides. The acid salt is correctly named.

ACID PHOSPHATE POWDERS.

7465. *Davis's O. K. Baking Powder,* made by R. B. Davis, N. Y. Purchased from Dunn & Ross, Auburn. In half pound tin. Price per can 20 cents. Cost per ounce 2.1 cents. Guaranteed acid phosphate, starch and bicarbonate of soda. The acid salt is correctly named.

7469. *Horsford's Self Raising Bread Preparation,* made by Rumford Chemical Works, Providence, R. I. Purchased from C. H. Cloutier, Lewiston. In half pound paper package. Price per package 25 cents. Cost per ounce 2.2 cents. Guaranteed acid phosphate, starch and bicarbonate of soda. The acid salt is correctly named.

7463. *Rumford's Baking Powder,* made by Rumford Chemical Works, Providence, R. I. Purchased from John Dingley Co., Auburn. In half pound tin. Price per can 15 cents. Cost per ounce 1.8 cents. Guaranteed strictly pure phosphate powder. The acid salt is correctly named.

ALUM POWDER.

7472. *Bon Bon Baking Powder,* made by J. C. Grant Chemical Co., East St. Louis. Purchased from Biddeford Grocery Co., Biddeford. In one pound tin. Price per can 12 cents. Cost per ounce .07 cents. Guaranteed double sulphate of aluminum, starch and bicarbonate of soda. The claim that it is an alum powder is correct.

TARTRATE-ALUM POWDER.

7477. *Ocean Baking Powder,* made by Ocean Mill, Montreal, P. Q. Purchased from Alex Quirion, Waterville. In quarter pound tin. Price per can 10 cents. Cost per ounce 2.2 cents. These were old goods and carried no guarantee. They have been withdrawn from market. Both tartaric acid and alum were found in the goods.

ACID PHOSPHATE-ALUM POWDER.

7473. *Biskit Baking Powder,* made by the Biskit Baking Powder Company, Boston. Purchased from J. O. Sullivan, Biddeford. In quarter pound tin. Price per can 10 cents. Cost per ounce 2.3 cents. Guaranteed acid calcium phosphate, alum, starch and bicarbonate of soda. The acid salts are correctly named.

TARTRATE-ALUM-ACID PHOSPHATE POWDER.

7466. *Grand Union Baking Powder,* made by the Grand Union Tea Co., Brooklyn, N. Y. Purchased from Grand Union Tea Co., Lewiston. In one pound tin. Price per can 50 cents. Cost per ounce 3 cents. The label states that the baking powder contains cream of tartar, acid phosphate, alum, starch and bicarbonate of soda. The acid salts are correctly named.

7468. *I. C. Baking Powder*, made by Jacques Mfg. Co., Chicago, New York and Kansas City. Purchased from C. H. Cloutier, Lewiston. In 10-ounce tin. Price per can 10 cents. Cost per ounce 0.9 cents. These are old goods and the dealer stated that he would procure the proper labels. A year ago the manufacturer said that the label now used stated that the powder consists of calcium acid phosphate and basic aluminum sulphate. In addition to alum and acid phosphate, the sample here examined carried tartaric acid.

SPICES.

Spices are vegetable materials which depend for their use upon the pungency which they possess to give flavor or relish to food. As such they are of considerable importance dietetically, but from the fact that they are used in such small amounts, they have actually little nutritive value. Spices are, however, of great interest to the public because of all food materials, they are more susceptible than other classes to fraudulent adulteration of the more skilled variety. In many cases not only the general appearance and taste of the skillful adulterated article are made to counterfeit the genuine spices, but even the miscroscopical appearance is intended to deceive. It is very rare that the microscope fails to detect the presence of any foreign substance in spice and hence its use is indispensable and in some respects more important than chemistry in the examination of spices. In most cases, however, both the microscopical and chemical determinations are necessary that the information given by one method may supplement that of the other.

The two most important chemical determinations are ash and ether extract. The miscroscope will betray even the presence or traces of foreign substances and of course such traces are liable to be present in the most carefully manufactured goods. Most manufacturers use the same mill for grinding different

spices, hence in an imperfectly cleaned mill, a trace of the spice last ground is liable to be carried to that which is being ground. The mechanical purification of the spices before they are ground, frequently presents such difficulties that even the unground spices are not strictly pure.

The samples of spices collected by the Station inspector, have been subjected to both chemical and miscroscopical examination. For the very full and careful microscopical examination, we are indebted to the experts of the Bureau of Chemistry of the U. S. Department of Agriculture at Washington. The chemical examinations were made in the Station laboratory.

Probably in no class of products is there greater variation in quality, than in commercial spices. A spice may be perfectly pure, so far as freedom from adulteration is concerned, and still be markedly inferior in quality. Furthermore the age of a spice and particularly the length of time that it has been powdered and the kind of a package in which it has been kept has much to do with the strength of spices. On reference to the standards adopted for Maine * the wide latitude that has to be given in composition even to pure spices is indicated.

The best way for the retailer to insure good quality is to buy of firms who purchase only the best grades of whole spices and powder them in their own mills. The consumer is best protected by buying the best from reliable retailers. The price paid per pound will usually be a guide to quality. A specially low priced spice must of necessity be either inferior in quality or adulterated.

A discussion of the different kinds of spices examined showing the results of the chemical and microscopical examinations follow.

ALLSPICE OR PIMENTO.

Allspice is the dried fruit of *Eugenia pimenta,* an evergreen tree belonging to the same family as the clove. It is indigenous in the West Indies and is especially cultivated in Jamaica. The berries are grayish or reddish brown in color; they are gathered when they have attained their largest size, but before becoming fully ripe. Though considerably less pungent than other spices, it possesses an aroma not unlike cloves and cassia.

* Bulletin 135, Maine Agricultural Experiment Station, pages 241-243.

While the samples of pimento differed very materially in quality, all of the samples but one were genuine. The Golden Crown allspice (No. 7196), madė by the Boston Supply Co., was largely adulterated with what seems to be under the microscope roasted pea flour. It is possible that the trace of red pepper found was added to this sample, as well as that of No. 7202, for the purpose of giving apparent strength. The excessive amount of starch and the low ether extract in sample No. 7196 are explained by the addition of the roasted pea flour.

The analysis of the different brands of allspice are given on pages 262-263.

CASSIA AND CINNAMON.

The names cassia and cinnamon are used interchangeably in commerce though strictly speaking they represent two distinct species of a genus belonging to the laurel family. In the food standards, little attempt is made to distinguish between cassia and cinnamon. The best quality of cinnamon is the bark of *Cinnamonum zeylanicum,* a tree from 20 to 30 feet high, native to the island of Ceylon, cultivated in some parts of tropical Asia, Sumatra, and Java. The entire yield of pure Ceylon cinnamon is extremely small and but little of it comes to America. The cheaper and more common cassia is the bark of *Cinnamonum cassia* which comes from China and India. It is darker in color than true cinnamon bark, of coarser texture and thicker. Both cinnamon and cassia barks are very aromatic in taste, somewhat astringent and slightly sweet.

Cassia buds are the dry flour buds of China cassia and are in the market both in whole and powder form. The powdered cassia or cinnamon of commerce consists of a mixture of several varieties of bark, and the cheaper grades contain an admixture of the ground buds.

The samples examined were genuine, with the exception that some of them contained traces of foreign matter, either wood tissue or of some other spice. These traces are probably accidental and not purposely added. There was, however, a great difference in the pungency of the different samples, which is due either to the quality of the whole cinnamon used, or to the length of time since grinding.

The analysis of the different brands of cinnamon are given on pages 262-265.

18

CLOVES.

Cloves are the dried flower buds of the clove tree *Caryophyllus aromatious,* which belongs to the Myrtle family, as also does the Allspice. The tree is an evergreen from 20 to 40 feet in height, and is cultivated extensively in Brazil, the West Indies, India and Zanzibar. The green buds in the process of growth, change to a reddish color, at which stage they are removed from the tree, spread out in the sun and allowed to dry, the color changing to the familiar deep brown of the cloves of commerce. One of the most valuable ingredients of the clove is the volatile clove oil. The ground cloves of commerce are liable to be deficient in clove oil because when exposed to the air, it gradually disappears. As there is a great demand for oil of cloves, it gives the temptation to partially extract the oil from the ground cloves of commerce. Furthermore, as there will always be more or less of the stems with the clove buds even pure ground cloves will frequently contain some of the stem. In most of the samples here examined, clove stems were present from traces to a large amount. Only in two samples, Nos. 7215 and 7217 did there seem to be a particularly unusual large amount of clove stems. Other than clove stems, no adulterant was found in the cloves examined. The different samples, however, differ considerably in quality, which may have been due to age or partial exhaustion of the cloves.

The analysis of the different brands of ground cloves examined are given on pages 264-267.

GINGER.

Ginger is the washed and dried, or decorticated (scraped) and dried root stalk of *Zinziber zingiber,* an annual herb growing to a height of from 3 to 4 feet. It is a native of India and China, but is quite extensively cultivated in tropical America, Africa and Australia. The root is dug when the plant is a year old and when the stem has withered. If when freshly dug and scalded to prevent sprouting, it is dried at once, it forms the so-called black ginger of commerce. When decorticated it furnishes what is known in commerce as white ginger. The best variety of white ginger is Jamaica ginger. The scraped root is sometimes bleached to make it still whiter, or may be sprinkled with carbonate of lime. The light colored decorticated ginger is usually selected for grinding.

There are two kinds of exhausted ginger commercially available for admixture as an adulterant. One is the product left after the extraction with strong alcohol, in the making of extract of Jamaica ginger; and the other the residue from extraction with either dilute alcohol or with water in the manufacture of ginger ale. It is rarely substituted wholly for the pure variety because the lack of pungency would make the adulteration too evident. It is used to mix with unexhaused ginger in varying proportions, and is also used as an adulterant for other spices. It is to its volatile oil that ginger is indebted for most of its aromatic qualities. So far as ginger was concerned, all of the samples examined were genuine, but a number of the samples, notably Nos. 7165, 7170, 7171, 7173 and 7174 were weak to the taste as if exhausted ginger had been added. This, however, may have been due to the long keeping of the ground goods in paper.

The analysis of the different brands of ground ginger examined are given on pages 266-269.

MACE.

Both nutmeg and mace occur in the fruit of several varieties of myrtle trees. The nutmeg tree is a native of the Malay Archipelago and grows from 20 to 30 feet high, somewhat resembling an orange tree in appearance. The crimson colored aril that surrounds the nutmeg kernel has many narrow flattened lobes. In the process of drying to form the mace of commerce, it loses its brilliant red color and turns a yellowish brown. Bombay mace is almost devoid of odor and even though it is a variety of mace, should be considered as an adulterant from its lack of pungency. Because of the high price of mace, there is particular temptation for adulterating it. Five of the samples of mace examined were strictly pure. Three contained traces of ginger. One was adulterated with corn meal, and two adulterated with Bombay mace. Where a large amount of Bombay mace was used, nutmeg was added to bring up the flavor. In purchasing ground mace, care should be taken to purchase that from reputable spice mills.

The analyses of the different brands of powdered mace examined are given on pages 268-269.

MUSTARD.

There are a large number of species of mustard, but mustard seed of commerce should be either the white mustard, *Sinapis alba,* or black or brown mustard, *Brassica nigra,* or *Brassica juncea.* As there are a large number of wild mustards which infest mustard as well as other fields, it frequently is well nigh a mechanical impossibility to obtain a mustard seed free from wild mustard. Many of the mustards collected by the Station contain the ground seeds of *Brassica arvensis.**

Ground mustard as defined by the food standards, is a powder made from mustard seed with or without the removal of the hulls and a portion of the fixed oil. There was formerly a more or less prevalent idea that pure mustard would lump unless starch or flour were mixed with it. In the case of 4 of the samples examined, foreign starches were present in more or less quantities. These were probably not added in the ordinary sense of adulteration but to prevent caking.

Sample No. 7081 was labeled as a compound mustard which explains the presence of the legumes and wheat flour. Three of the samples carried more or less turmeric. While turmeric possesses some value as a condiment in itself, it being, for instance, the chief ingredient in curry powder, it is added to mustard merely to improve the color. While under the Maine Pure Food law its use would be admissable if its presence is stated upon the label, its presence unnoted is an adulteration.

The analyses of the different brands of mustard examined are given on pages 270-271.

BLACK AND WHITE PEPPER.

Black pepper is the dried immature berry of the pepper plant, *Piper nigrum,* a climbing shrub growing to the height of 12 to 20 feet; a native of the East Indies but cultivated in many tropical countries. When the fruit begins to turn red, it is gathered and dried. In this process, it turns black and shrivels up, forming the black peppercorns of commerce.

White pepper is obtained by decorticating (removing hulls or shells) the fully ripened black peppercorns. The pepper hulls

*The seed is thus identified by the Bureau of Chemistry, but is probably the same as *Brassica campestris.*

or shells obtained in making white pepper out of black are very largely used as an adulterant for black pepper and to some extent for spices. Many of the samples of black pepper here reported seem to carry too large an amount of pepper shells or hulls. Of course it is difficult under the microscope to make a quantitative examination of such materials, but it is doubtful if in the case of all the samples indicated as containing an excess of pepper hulls, that they were added fraudulently. As is well known the quality of pepper deteriorates rapidly on exposure to the air and the loss of strength of some of the peppers here reported may have been due to age. For the most part, the white peppers seemed to be genuine although 3 of the samples carried more pepper hulls than should be present. From its process of manufacture, white pepper should be practically free from hulls.

The analysis of the different brands of grade pepper examined are given on pages 272-275.

CAYENNE OR RED PEPPER.

Cayenne pepper is the dried fruit of several species of *Capsicum*, a genus of the nightshade family, native of the American tropics but now cultivated in nearly all warm countries. The ordinary garden species of red pepper is *Capsicum annuum* of which there are over 30 varieties in cultivation in this country. The Cayenne and Chili varieties are most highly priced because of their pungency. While differing greatly in flavor, partly due to age and partly to the species of Capsicum from which they were made, all of the samples of ground red or cayenne pepper were genuine.

The analysis of the different brands of red peppers examined are given on pages 274-275.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
ALLSPICE OR PIMENTO.			cts.	lbs.	
Slade's.	D. & L. Slade Co., Boston, Mass.	James H. Snow & Co., Bangor	8	.23	7190
Slade's allspice.	D. & L. Slade & Co., Boston, Mass.	John B. Johnson, Portland	7	.23	7191
Premier Jamaica.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	10	.25	7192
Pimento.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	8	.22	7193
Allspice.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor, Maine	10	.17	7194
Allspice.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland	10	.18	7195
Golden Crown.	Boston Supply Co., Boston, Mass.	W. J. Eldridge, Foxcroft	6	.24	7196
Shaw's pimento.	Dwinell, Wright & Co., Boston, Mass.	Geo. C. Shaw & Co., Portland	8	.25	7197
Three Crow brand.	John Bird Co., Rockland.	Lewiston Tea & Coffee Co., Lewiston	6	.23	7198
Pimento.	Stickney & Poor, Boston, Mass.	W. L. Wilson Co., Portland	8	.27	7199
Choicest allspice.	A. Colburn Co., Philadelphia, Pa.	Brennan & Curran, Bangor	7	.26	7200
Royal Brand pimento.	Dwinell, Wright Co. Boston, Mass.	W. P. Stewart & Co., Waterville	6	.24	7201
Hatchet Jamaica allspice.	Twitchell-Champlin Co., Portland and Boston.	F. H. Verrill, Portland	8	.23	7202
Premier allspice.	Francis H Leggitt & Co., New York.	James H. Snow & Co., Bangor	8	.26	7203
Slade's allspice in bulk.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	....	......	7204
Pimento in bulk.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	....	.....	7205
CASSIA AND CINNAMON.					
Slade's.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	5	.24	7221
Slade's.	D. & L. Slade Co., Boston, Mass.	John B. Johnson, Portland	7	.24	7222
Three Crow brand.	John Bird Co., Rockland.	Lewiston Tea & Coffee Co., Lewiston	6	.25	7223

Station number.	Ash.		Crude fiber.	Starch.	Ether extract.		Foreign matters found.
	Total.	Insoluble in HCl.			Volatile.	Non-volatile.	
	%	%	%	%	%	%	
7190	4.53	.87	24.93	13.77	3.70	4.00	None.
7191	4.48	.49	24.55	12.69	3.70	3.75	None.
7192	4.62	.49	23.15	15.66	3.65	3.31	None.
7193	5.42	.35	20.05	16.47	2.63	4.60	None.
7194	4.63	.05	22.18	16.74	3.55	5.05	None.
7195	4.98	.10	26.20	16.20	4.40	3.10	None.
7196	5.08	.93	12.78	28.08	2.58	2.77	A leguminous product, apparently roasted pea flour. Trace of red pepper.
7197	4.45	.10	21.93	17.82	4.30	4.86	Trace of ginger.
7198	4.75	.05	22.28	16.47	3.55	2.23	None.
7199	4.65	.13	23.53	14.03	4.30	4.14	None.
7200	4.13	.10	24.75	16.20	2.43	3.67	None.
7201	4.96	.10	23.68	15.12	3.45	4.25	None.
7202	4.53	.05	23.83	16.20	4.25	3.75	Trace of red pepper.
7203	4.58	.13	24.85	17.55	2.85	3.65	None.
7204	4.65	.16	21.20	16.47	3.30	4.13	None.
7205	4.69	.05	22.33	16.74	4.08	2.65	None.
7221	2.55	.10	23.00	20.05	0.95	1.28	Trace wood tissue.
7222	3.49	.70	23.03	17.00	1.00	1.23	Trace wood tissue.
7223	3.33	.70	22.35	21.33	1.13	1.17	Trace foreign starches.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
			cts.	lbs.	
CASSIA AND CINNAMON.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor	10	.21	7224
	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland	10	.120	7225
Premier Ceylon.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	12	.126	7226
Cassia.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	8	.23	7227
Premier brand.	Francis H. Leggitt & Co., New York.	James H. Snow & Co., Bangor	8	.25	7228
Royal brand cassia.	Dwinell, Wright & Co., Boston, Mass.	W. P. Steward & Co., Waterville	7	25	7229
Hatchet brand Batavia cassia.	Twitchell-Champlin Co., Portland, and Boston, Mass.	F. H. Verrill, Portland	8	.23	7230
Cassia.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	10	.25	7231
Cassia.	S. S. Pierce Co., Boston, Mass.	James H. Snow & Co., Bangor	25	.25	7232
Colburn's choicest cinnamon.	A. Colburn Co., Philadelphia, Pa.	Brennan & Curran, Bangor	7	.25	7233
Shaw's cassia.	Dwinell, Wright Co., Boston, Mass.	Geo. C. Shaw Co., Portland	8	.26	7234
Bulk cinnamon.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	....	......	7235
Bulk cinnamon.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	....	......	7236
Bulk cinnamon.	Bennett & Simpson.	Wm. Milliken & Co., Portland	....	......	7237
CLOVES.					
Ground cloves.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	5	.24	7206
Premier Amboyna cloves.	Stickney & Poor, Boston, Mass.	F. T. Hall & Co., Bangor	10	.34	7207
Cloves.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	8	.24	7208
Cloves.	Stickney & Poor, Boston, Mass.	John B. Johnson, Portland	7	.25	7209
Cloves.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor	10	.19	7210

Station number.	Ash.		Crude fiber.	Starch.	Ether Extract.		Foreign matter found.
	Total.	Insoluble in HCl.			Volatile.	Non-volatile.	
	%	%	%	%	%	%	
7224	3.44		20.30	17.28	1.30	1.08	None.
7225	4.04	.70	21.28	17.00	0.95	1.15	Trace ginger and wood tissue.
7226	3.90	.25	21.18	19.98	1.88	1.00	Trace allspice.
7227	4.00	.48	21.80	16.47	0.80	0.95	Trace wood tissue.
7228	4.96	.70	22.58	20.38	0.60	0.95	None.
7229	2.90	.45	23.55	25.65	0.80	0.95	None.
7230	3.70	.35	21.40	18.63	1.05	0.83	Trace wood tissue.
7231	3.90	.43	21.88	18.63	0.98	0.97	None.
7232	4.35	.03	18.83	19.17	1.78	1.27	None.
7233	3.02	.65	23.75	22.68	0.88	1.22	Trace wood tissue.
7234	2.66	.45	23.00	25.38	0.83	1.25	None.
7235	3.15	.55	22.35	21.33	0.90	1.30	None.
7236	4.85	.58	13.75	12.96	1.83	4.57	Trace red pepper.
7237	4.56	.17	21.08	18.63	0.93	1.40	None.
7206	6.58	.63	9.53	5.80	15.47	7.52	Trace clove stems.
7207	6.60	.08	8.48	7.25	15.55	7.30	None.
7208	6.92	.35	9.68	6.52	13.49	5.92	Some clove stems.
7209	6.58	.05	9.98	8.41	12.52	6.13	Some clove stems.
7210	6.48	.63	7.93	6.38	18.09	6.65	None.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
			cts.	lbs.	
Cloves.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland	10	.19	7211
Ground cloves.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	8	.25	7212
Shaw's cloves.	Dwinell, Wright Co., Boston, Mass.	Geo. C. Shaw & Co., Portland	8	.24	7213
Colburn's choicest cloves.	A. Colburn Co., Philadelphia, Pa.	Brennan & Curran, Bangor	7	.25	7214
Three Crow brand.	John Bird Co., Rockland.	Lewiston Tea and Coffee Co., Lewiston	6	.24	7215
Hatchet brand Amboyna.	Twitchell-Champlin Co., Portland and Boston, Mass.	F. H. Verrill, Portland	8	.24	7216
Royal brand.	Dwinell, Wright Co., Boston, Mass.	W. P. Stewart & Co., Waterville	7	.23	7217
Premier brand.	Francis H. Leggitt & Co., New York.	James H. Snow & Co., Bangor	10	.25	7218
Bulk cloves.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	....	......	7219
Bulk cloves.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	....	......	7220
GROUND GINGER.					
Three Crow brand.	John Bird Co., Rockland.	Atwood Market Co., Lewiston	6	.24	7161
Ginger.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor	10	.17	7162
Ginger.	Grand Union Tea Co. Brooklyn, N. Y.	Grand Union Tea Co., Portland	10	.19	7163
Premier Borneo.	Stickney & Poor, Boston, Mass.	F. T. Hall & Co., Bangor	10	.28	7164
Ginger.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	8	.25	7165
African ginger.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	5	.25	7166
Slades' ginger.	D. & L. Slade Co., Boston, Mass.	John B. Johnson, Portland	7	.25	7167
Ginger.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	6	.24	7168
Ginger.	Stickney & Poor,* Boston, Mass.	Great China and Pacific Tea Co., Bangor	5	.25	7169

* Put up for the Great China and Pacific Tea Company.

Station number.	Ash. Total.	Ash. Insoluble in HCl.	Crude fiber.	Starch.	Ether Extract. Volatile.	Ether Extract. Non-volatile.	Foreign matters found.
	%	%	%	%	%	%	
7211	6.86	.65	8.58	6.96	17.66	6.64	Some clove stems.
7212	5.88	.48	9.45	7.25	17.40	5.73	Some clove stems.
7213	7.14	.48	9.53	5.80	15.79	5.99	Some clove stems.
7214	6.89	.50	14.38	7.25	11.90	5.95	Trace clove stems.
7215	7.75	.30	12.45	7.54	8.04	5.98	Largely clove stems.
7216	6.90	.43	10.03	7.54	13.65	6.00	Some clove stems.
7217	6.70	.45	9.50	7.25	15.84	6.32	A large proportion of clove stems.
7218	7.58	.83	10.88	7.83	14.52	7.11	Some clove stems.
7219	7.32	.33	11.33	6.38	12.85	6.69	Some clove stems.
7220	7.20	.30	10.88	6.00	11.03	8.35	Some clove stems.
7161	5.00	.50	4.90	49.60	2.00	4.73	None.
7162	5.85	.55	5.90	49.60	3.30	4.35	None.
7163	5.85	.15	5.40	52.60	3.28	4.12	None.
7164	4.50	.50	4.20	55.62	2.60	3.30	None.
7165	7.25	2.43	5.90	48.50	1.58	3.52	None.
7166	6.48	1.80	6.15	47.68	2.43	3.55	None.
7167	6.45	1.60	6.30	47.95	2.90	3.30	None.
7168	6.45	1.80	5.43	48.75	3.10	3.45	None.
7169	8.10	3.13	5.98	45.75	1.25	3.39	None.*

* Taste weak as if exhausted ginger was used.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
GINGER.			cts.	lbs.	
Royal brand.	Dwinell, Wright Co., Boston, Mass.	W. P. Stewart & Co., Waterville............	6	.26	7170
Jamaica ginger.	S. S. Pierce Co., Boston, Mass.	James H Snow & Co., Bangor................	15	.30	7171
Hatchet brand African.	Twitchell-Champlin Co., Portland and Boston, Mass.	F. H. Verrill, Portland..............	8	.23	7172
Premium brand.	Francis H. Leggitt & Co., New York, N.Y.	James H. Snow & Co., Bangor............ ...	10	.20	7173
Colburn's ginger.	C. Colburn & Co., Philadelphia, Pa.	Brennan & Curran, Bangor................	7	.25	7174
Bulk Jamaica ginger.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor....	....	......	7175
Bulk ginger.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland..............	....	......	7176
Bulk ginger.	Bennett & Simpson,	Wm. Milliken & Co., Portland...	...	.....	7177
GROUND MACE.					
Bulk mace.	....	Grand Union Tea Co., Bangor..	....	......	7178
Bulk mace.	Bennett, Simpson & Peep, London, Eng.	James H. Snow & Co., Bangor................	.. .	......	7179
Bulk mace.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland..............	....	......	7180
Durkee's mace.	E. R. Durkee & Co.,	James H. Snow & Co., Bangor................	10	.06	7181
Premium.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor................	10	.06	7182
Premium.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland..............	10	.07	7183
Slade's mace.	D. & L. Slade Co., Boston, Mass.	John B. Johnson, Portland..............	8	.06	7184
Colburn's mace.	A. Colburn & Co, Philadelphia, Pa.	Brennan & Curran, Bangor................	10	.07	7185
Slade's mace.	S. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor................	10	.06	7186
Shaw's mace.	Dwinell, Wright Co., Boston, Mass.	Geo. C. Shaw Co., Portland..............	18	.09	7187
Hatchet brand.	Twitchell-Champlin Co., Portland and Boston, Mass.	W. S. Ham, Foxcroft..............	8	.05	7188
Royal brand.	Dwinell, Wright Co., Boston, Mass.	W. P. Stewart & Co., Waterville............	16	.09	7189

Station number.	Ash. Total.	Ash. Insoluble in HCl.	Crude fiber.	Starch.	Ether extract. Volatile.	Ether extract. Non-volatile.	Foreign matters found.
	%	%	%	%	%	%	
7170	7.03	1.80	5.98	52.88	1.50	3.35	None.
7171	4.18	.25	2.75	57.27	1.68	2.57	None.
7172	5.13	.58	5.20	54.54	2.53	5.25	None.
7173	4.83	.65	4.40	57.26	1.85	4.60	None.
7174	5.38	1.80	3.75	61.66	1.00	2.80	None.*
7175	5.65	.80	5.48	55.08	2.15	4.48	Apparently not scraped and bleached.
7176	5.60	1.20	5.73	51.78	2.13	4.52	None.
7177	4.33	.33	4.03	57.28	2.98	2.87	None.
7178	3.46	.98	4.48	30.65	4.55	24.90	Trace of ginger.
7179	3.65	.40	4.98	22.55	6.75	31.41	Bombay mace.
7180	3.60	.47	6.08	21.87	6.05	27.50	None.
7181	4.13	1.22	4.50	29.70	3.50	27.78	None.
7182	3.65	2.95	6.20	20.79	5.09	29.66	None.
7183	3.60	.44	5.83	20.52	4.00	31.69	None.
7184	2.79	.43	3.68	29.15	7.67	27.65	None.
7185	2.90	.43	3.73	33.70	5.49	23.38	Corn meal. Trace ginger.
7186	3.42	.45	5.03	25.10	8.03	26.74	Small amount nutmeg.
7187	2.50	.30	3.73	28.62	5.69	25.99	Trace ginger.
7188	2.42	.35	6.30	17.01	2.28	50.59	Largely Bombay mace, a little nutmeg.
7189	2.33	.28	4.03	21.05	5.61	31.55	Trace ginger.

* Taste weak as if exhausted ginger was used.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
			cts.	lbs.	
MUSTARD.					
Purity brand.	Manufacturer not given.	James H. Snow & Co., Bangor...............	20	.51	7080
Keene's mustard.	Manufactured in England.	Fred T. Hall & Co., Bangor...	20	.23	7081
Keene's mustard.	Manufactured in England.	James H. Snow & Co., Bangor................	20	.24	7082
Colburn's mustard.	Manufacturer not given.	Fred T. Hall & Co., Bangor................	10	.26	7083
Premium mustard.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor................	10	.26	7084
Mustard.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland..............	10	.27	7085
Barrus mustard.	Manufacturer not given.	Wm. Scott, Bangor	10	.29	7086
Double superfine.	Firth, Cole & Co., London, Eng.	Fisher & Crocker Co., Bangor................	10	.24	7087
Extra English.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor................	10	.25	7088
Slade's Oxford.	D. & L. Slade Co., Boston, Mass.	A. J. McNaughton, Foxcroft...............	10	.26	7089
English Durham.	Atkinson & Jones, London, Eng.	W. S. Ham, Foxcroft...............	5	.18	7090
Royal.	Dwinell, Wright & Co., Boston, Mass.	W. P. Stewart & Co., Waterville............	17	.55	7091
Bennett's.	Bennett, Simpson & Peep, London, Eng	W. L. Wilson & Co., Portland, Maine......	10	.24	7092
Mustard.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor................	10	.21	7093
Mustard.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland...............	10	.25	7094
BLACK PEPPER.					
Pepper.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor................	10	.18	7123
Pepper.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland...............	10	.21	7124
Colburn's pepper.	A. Colburn Co., Philadelphia, Pa.	Brennan & Curran, Bangor................	7	.24	7125
Slade's pepper.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor...	5	.24	7126

Station number.	Ash. Total.	Ash. soluble in HCl.	Crude fiber.	Starch.	Ether extract. Volatile.	Ether extract. Non-volatile.	Foreign matters found.
	%	%	%	%	%	%	
7080	13.02	.82	3.05	1.19	2.30	14.68	Wheat flour. Brassica arvensis.* Trace arrow root.
7081	3.91	.10	1.54	1.24	4.53	30.11	A leguminous seed, a little wheat flour.
7082	4.44	.05	4.45	.25	2.00	35.15	None.
7083	6.60	1.10	4.10	.73	2.90	18.63	Trace turmeric.
7084	6.45	.30	3.40	.68	2.18	15.47	None.
7085	5.85	.35	4.03	.62	2.25	20.18	Brassica arvensis.*
7086	5.58	.35	5.85	.28	2.18	19.15	Brassica arvensis.* Apparently no attempt to remove seed coats.
7087	5.79	.65	4.00	.68	1.83	12.62	Brassica arvensis.*
7088	6.13	.95	4.43	58	1.20	23.23	None.
7089	5.60	.40	4.13	.58	1 90	22 05	Trace of red pepper.
7090	5.66	.55	12.15	.18	4.23	10.20	Turmeric, apparently no attempt to remove seed coats.
7091	6.30	.55	4.75	.48	.98	20.47	Brassica arvensis.* Trace wheat starch.
7092	7.03	.73	2.88	.24	4.90	13.20	Trace of starch.
7093	6.13	.53	4.90	....	1.80	16.55	Brassica arvensis.* Turmeric.
7094	5.68	.40	4.78	....	1.38	19.15	Brassica arvensis.* Turmeric.
7123	5.63	.89	16.08	32.64	1.34	9.13	None. An excess pepper hulls.†
7124	6.23	1.55	11.85	36.18	1.22	8.88	None. An excess pepper hulls.†
7125	8.00	1.90	14.58	31.28	0.94	7.61	None. An excess pepper hulls.†
7126	5.43	1.30	12.30	37.27	1.04	8.91	None.

* See discussion page 260.

† See discussion page 261.

Brand.	Manufacturer.	Dealer and Town.	Price paid.	Weight of contents.	Station number.
BLACK PEPPER.			cts.	lbs.	
Slade's pepper.	D. &. L. Slade Co., Boston, Mass.	John B. Johnson, Portland	7	.23	7127
Royal black pepper.	Dwinell, Wright Co., Boston, Mass.	W. P. Stewart & Co., Waterville	7	.23	7128
Premium pepper	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	10	.29	7129
Hatchet black pepper.	Twitchell-Champlin Co., Portland, and Boston, Mass	F. H. Verrill, Portland	8	.23	7130
Premier.	Francis H. Leggitt & Co.. New York.	James H. Snow & Co., Bangor	10	.24	7131
Absolutely pure black pepper.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland	8	.25	7132
Genuine Malabar	Bennett-Simpson Co , London, Eng.	Wm. Milliken & Co., Portland	10	.24	7133
Shaw's	Dwinell, Wright Co., Boston, Mass.	Geo. C. Shaw Co., Portland	8	.25	7134
Black pepper.	John Bird Co., Rockland, Maine.	Atwood Market Co., Lewiston	6	.23	7135
Bulk pepper.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor			7136
Bulk black pepper.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland			7137
WHITE PEPPER.					
Hatchet brand.	Twitchell-Champlin Co., Portland, and Boston, Mass.	F. H. Verrill, Portland	10	.14	7138
Shaw's.	Dwinell & Wright Co., Boston, Mass.	Geo. C. Shaw Co., Portland	10	.16	7139
Slade's.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor	10	.12	7140
White pepper.	Stickney & Poor, Boston, Mass.	John B. Johnson, Portland	8	.12	7141
White pepper.	Grand Union Tea Co , Brooklyn, N. Y.	Grand Union Tea Co, Bangor	13	.14	7142
White pepper.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland	10	.14	7143
Premium.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor	12	.26	7144
White pepper.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co , Portland	10	.24	7145

Station number.	Ash.		Crude fiber.	Starch.	Ether extract.		Foreign matters found.
	Total.	Insoluble in HCl.			Volatile.	Non-volatile.	
	%	%	%	%	%	%	
7127	5.10	.53	15.45	34.55	1.33	8.53	None.
7128	5.55	.62	16.15	35.50	0.99	9.44	None. An excess pepper hulls.*
7129	5.00	.62	13.08	36.72	1.32	9.09	None. An excess pepper hulls.*
7130	4.58	.90	10.93	39.72	0.95	7.73	None.
7131	4.82	.50	14.28	37.54	1.14	8.03	None. An excess pepper hulls.*
7132	5.50	.34	13.93	36.85	1.13	9.67	None. An excess pepper hulls.*
7133	5.40	.48	11.63	39.72	0.95	8.80	None.
7134	5.90	1.20	13.78	36.85	0.95	8.17	None. An excess pepper hulls.*
7135	5.78	1.10	11.95	41.08	1.40	6.95	None. An excess pepper hulls.*
7136	4.78	.68	10.98	37.54	1.68	6.70	None. An excess pepper hulls.*
7137	5.10	.85	12.85	37.27	1.75	7.15	None.
7138	1.00	.05	4.73	58.64	0.44	8.47	None.
7139	1.25	.23	4.23	55.62	0.21	7.94	None.
7140	1.05	.02	3.55	58.10	0.34	8.55	None.
7141	1.38	.28	4.83	55.62	0.61	7.71	Trace ginger.
7142	1.40	.15	3.95	57.82	0.48	6.80	None. Too many pepper hulls.*
7143	1.20	.13	4.90	59.46	0.58	7.14	None. Too many pepper hulls.*
7144	1.25	.20	4.73	55.90	0.76	7.92	None.
7145	1.06	.20	4.95	58.90	0.50	7.87	None.

*See discussion page 261.

Brand.	Manufacturer.	Dealer and town.	Price paid.	Weight of contents.	Station number.
WHITE PEPPER.			cts.	lbs.	
Royal.	Dwinell, Wright Co., Boston, Mass.	W. P. Stewart & Co., Waterville............	10	.25	7146
Premier brand.	Francis H. Leggitt & Co., New York.	James H. Snow & Co., Bangor................	12	.25	7147
Bulk white pepper.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin. Bangor................	....	.....	7148
Bulk white pepper.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland..............	....	......	7149
Three Crow white pepper.	John Bird Co., Rockland.	H. C. Haskell, Waterville.......... ...	8	.25	7150
CAYENNE OR RED PEPPER.					
Shaw's.	Dwinell, Wright Co., Boston, Mass.	Geo. C. Shaw Co., Portland...............	10	.16	7151
Cayenne pepper.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Bangor................	13	.21	7152
Cayenne pepper.	Grand Union Tea Co., Brooklyn, N. Y.	Grand Union Tea Co., Portland, Maine......	10	.20	7153
Slade's.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor................	10	.12	7154
Slade's.	D. & L. Slade Co., Boston, Mass.	John B. Johnson, Portland..............	8	.12	7155
Hatchet brand.	Twitchell-Champlin Co., Portland and Boston, Mass.	F. H. Verrill, Portland...............	10	.14	7156
Premier brand.	Francis H. Leggitt & Co., New York.	James H. Snow & Co., Bangor................	12	.24	7157
Premium brand, African.	Stickney & Poor, Boston, Mass.	Fred T. Hall & Co., Bangor................	12	.28	7158
Cayenne pepper.	Stickney & Poor, Boston, Mass.	W. L. Wilson & Co., Portland...	10	.13	7159
Bulk cayenne.	D. & L. Slade Co., Boston, Mass.	Staples & Griffin, Bangor...............	....	......	7160

Station number.	Ash. Total.	Ash. Insoluble in HCl.	Crude fiber.	Starch.	Ether extract. Volatile.	Ether extract. Non-volatile.	Foreign matters found.
	%	%	%	%	%	%	
7146	2.50	.25	4.70	55.62	0.42	7.28	None.
7147	1.38	.08	1.43	61.10	0.35	7.72	None.
7148	1.08	.10	4.15	55.90	0.42	7.55	None.
7149	1.15	.13	5.80	55.35	0.54	7.82	None.
7150	3.78	.40	5.35	54.80	0.40	6.94	Too many pepper hulls.*
7151	6.15	.48	25.08	9.30	3.90	13.73	None.
7152	6.34	.60	23.80	8.99	5.73	13.07	None.
7153	6.03	.25	23.30	6.67	3.58	15.75	None.
7154	5.80	.53	23.83	8.12	4.08	16.25	None.
7155	5.60	.53	23.78	8.70	5.70	14.55	None.
7156	6.35	.45	25.35	6.96	7.28	11.37	None.
7157	7.08	.45	24.90	8.70	3.10	15.60	None.
7158	7.60	.63	20.10	8.70	5.58	15.60	None.
7159	7.13	.48	22.70	6.24	4.30	14.88	None.
7160	6.33	.33	22.48	10.44	6.35	12.80	None.

* See discussion page 261.

Vinegars.

When alcohol is placed under favorable conditions it takes up oxygen from the air and is converted into acetic acid,—the acid that gives the sour taste to vinegar. Whatever the source of the vinegar, and however it is made, the acetic acid is the same.

Besides acetic acid, vinegar always contains more or less of other substances which vary widely with the source from which the vinegar was made. It is because of these foreign matters, characteristic of vinegar of the same kind, that it is possible for the chemist to quite readily distinguish one variety of vinegar from another. The sour taste of a vinegar is due to its acetic acid, the other flavors are due to foreign matters in solution. The standards which have been adopted for Maine take these other foreign matters into account. The standards for vinegars * will be sent to anyone desiring them.

RESULT OF THE INSPECTION.

Samples of vinegar were taken from the stock of retail dealers in several cities and large towns in the State in the months of September and October, 1906. These vinegars were examined for total acidity, volatile acids, total solids and ash. The nature of the solids and ash were not studied, except in a few special instances. For this reason it may be that an occasional sample of vinegar has been passed as a straight cider vinegar when it was adulterated. Ordinary adulterations would be detected by the methods employed by us. A skillful adulteration might have escaped detection.

The results of the analyses are given in the table on page 279.

While the inspector found the vinegar situation much better than it was a year ago, still the analyses shows that vinegars were on sale in the State that were not correctly branded. Correspondence has developed two things,—great readiness on the part of the manufacturers and wholesalers to meet the requirements of the pure food law; and considerable misunderstanding as to the requirements and how they are to be met. With the present attitude of the trade, both wholesale and retail, there is little reason to doubt that as fast as the requirements of the pure

* Bulletin 135 Maine Station page 249.

food law are understood they will be very generally complied with.

As the vinegar situation seemed to demand specific information relative to the requirements of the law, the enclosed circular, which is here reprinted in substance, was prepared for the wholesale trade to distribute among their customers.

Vinegar Defined.

The word *vinegar* used alone always means pure apple cider vinegar without any additions and containing at least 4 per cent acetic acid.

The words *Cider Vinegar* by themselves always refer to pure apple cider vinegar as defined above.

Wine vinegar always means vinegar made from grape juice. There is practically no wine vinegar used in Maine. The so-called white wine vinegar is a distilled vinegar and not a wine vinegar.

Malt Vinegar is made from barley malt. *Sugar Vinegar* is made from cane sugar products and *glucose vinegar* from starch sugar.

The above are undistilled vinegars made by fermentation.

Distilled vinegar is the product of fermentation of dilute distilled alcohol from any source. Cider vinegar and distilled vinegar are the kinds most commonly used in Maine.

Vinegar of any kind must contain at least *4 per cent acetic* acid to be up to the standard required by the pure food law.

The word *pure* cannot be legally used if a vinegar is not up to standard or contains any added foreign material.

In case a vinegar is colored by the addition of a solution of caramel (burnt sugar), the word "colored" will be construed as covering that fact. If any other kind of coloring material be used, the kind and amount per gallon must be stated.

Branding Vinegar.

Strictly pure apple cider vinegar containing not less than 4 per cent acetic acid does not require a label. All other kinds of vinegar must be "plainly labeled, branded or tagged so as to show the exact character thereof."

In order to be "plainly" branded the letters, if stencilled, should not be less than ¾ of an inch high, and applied with a waterproof ink to a clean painted surface. A printed label could be made up of somewhat smaller letters.

In case an apple cider vinegar carries any addition or is below strength it must be so labeled. For instance if the vinegar was considered too light in color and caramel (burnt sugar) is added the label must state this fact, e. g. "Apple Cider Vinegar, Colored" would be all right. If it is below 4 per cent acetic acid the label must state this fact, e. g. "Apple Cider Vinegar, 3½ per cent acetic acid." The word *pure* cannot be used even if the vinegar is made from cider and is below the standard (4) per cent or is colored.

An uncolored distilled vinegar may be labeled grain vinegar, spirit vinegar, distilled vinegar, white vinegar or pickling vinegar.

A colored distilled vinegar may be labeled as above but the word colored must appear, e. g. Grain vinegar, colored, Colored distilled vinegar, etc.

If any kind of vinegar carries less than 4 per cent acetic acid, that fact must be stated, e. g. White distilled vinegar 3 per cent acetic acid, or Colored grain vinegar 3 per cent acetic acid, etc.

A distilled vinegar up to the standard strength and not colored may be labeled pure, thus Pure grain vinegar is in accord with the law. An artificially colored vinegar cannot be labeled pure.

Retailers must so place the barrel from which they are selling that the brand can be readily seen and read.

If customers will take pains to read the brand upon the package they will know much better what kind of vinegar they are using.

While not required by the law, it is desirable that the name of the manufacturer or jobber be stated.

Description and results of analyses of samples of different kinds of vinegars collected in Maine in the fall of 1906.

Station number.	Manufacturer and dealer.*	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
	CIDER VINEGARS.	cts	%	%	%	%
7420	H. E. Bean, Biddeford. A country cider vinegar....................	25	5.45	5.34	1.72	.27
7426	A. H. Black, Sidney. E. Locke, Augusta	25	5.87	5.86	1.85	.35
7437	A. H. Black, Sidney. G. E. Barrows, Waterville.................	25	7.20	7.20	1.74	.32
7422	Jos. Carrier, Biddeford. A country cider vinegar....................	25	5.16	5.16	3.19	.48
7478	E. E. Clifford & Co., Portland. Neally & Miller, Lewiston.................	25	5.11	5.11	1.93	.30
7455	C. F. Dearth, Foxcroft Fred T. Hall & Co., Bangor.........	30	6.33	6.20	3.20	.21
7390	John Dingley & Co., Auburn. A country cider vinegar....................	25	6.55	6.14	3.02	.39
7406	Duffy Cider Co., Rochester, N. Y. O. C. Elwell, Portland	25	5.32	5.26	2.57	.29
7430	Duffy Cider Co., Rochester, N. Y. Percival Bros., Augusta	25	5.07	5.04	2.48	.30
7434	S. R. Dyer & Co., Kingston, N. Y. A. W. Peaslee, Gardiner	25	6.00	6.00	2.50	.28
7480	Chas. Haywood & Co., Bangor. McGary Bros., Houlton................	25	5.28	5.16	3.01	.29
7395	H. J. Heinz Co., Pittsburg, Pa. Atwood Market Co., Lewiston............	25	6.66	6.52	2.60	.34
7411	H. J. Heinz Co., Pittsburg, Pa. W. L. Wilson & Co., Portland	30	6.32	6.22	2.04	.28
7429	Fred Hewins, East Winthrop. C. W. Church, Augusta......................	25	6.04	5.98	3.33	.51
7459	R. E. Hovey & Co., Bangor	25	7.60	7.60	2.29	.41
7391	G. R. Hunnewell, Danville Junction. A. M. Penley & Son, Auburn	25	6.52	6.48	1.73	.28
7440	W. S. Hunnewell, China Geo. A. Kenniston, Waterville............	25	7.31	7.28	1.90	.33
7438	J. A. Jenkins, Winslow. C. E. Matthews, Waterville	25	6.21	6.16	1.82	.36
7436	B. F. Jepson, China. E. M. Jepson, Waterville. A poorly made straight cider vinegar..	25	3.58	3.54	2.14	.40
7447	Alonzo McIntyre, Skowhegan. Geo. Simpson, Skowhegan. A poorly made straight cider vinegar..	25	3.24	3.14	3.19	1.16
7407	Morrill & Ross, Portland	25	6.42	6.42	2.53	.27

* When two names are given, the first is that of the manufacturer.

Description and results of analyses of samples of different kinds of vinegars collected in Maine in the fall of 1906.

Station Number.	Manufacturer and Dealer.*	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
	CIDER VINEGARS.	cts.	%	%	%	%
7419	Jos. Menard, Biddeford. A country cider vinegar; a poorly made vinegar which Mr. Menard withdrew from sale	20	2.86	2.86	2.60	.35
7394	C. N. Penney, Auburn	25	3.98	3.98	2.57	.33
7408	J. F. Pillsbury, Lewiston. Geo. C. Shaw Co., Portland	25	6.26	6.10	2.89	.38
7432	R. C. Plaisted, Gardiner. F. N. Noyes, Gardiner	25	5.36	5.36	1.53	.52
7435	R. C. Plaisted, Gardiner. F. M. Moores, Gardiner	25	4.49	4.48	1.46	.43
7417	——Ross, Clark's Mills. Joel Bean & Son, Biddeford. A poorly made cider vinegar.	25	3.39	3.32	2.47	.38
7433	A. M. Sawyer, West Gardiner. Wm. Wood & Son Gardiner	25	7.52	7.52	1.57	.43
7414	Geo. C. Shaw Co., Portland. A country cider vinegar	25	4.47	4.47	2.43	.28
7396	John Sturgis,—— A. P. Conant & Co., Lewiston	25	5 86	5.84	2.27	.35
7425	J. O. Sullivan & Sons, Biddeford. Manufacturer unknown,—bought in Boston	25	6.25	6.24	3.14	.42
7405	Twitchell-Champlin Co., Portland. Scannell & Roche, Lewiston	25	5.92	5.78	4.31	.45
7410	A. G. Tufts, New Gloucester. J. W. Deering & Son, Portland	25	5.06	5.04	1.47	.32
7449	John Watson Co , Houlton. Chas. H. Wilson, Houlton	25	5.15	5.08	2.24	.23
7424	C. A. Weston Co., Portland. Murphy Bros., Biddeford	25	4.90	4.80	2.16	.40
7412	W. L. Wilson & Co., Portland. A country cider vinegar	25	5.39	4.99	3.44	.36
7445	Geo. Wing, Skowhegan. Geo. S. Webb, Skowhegan	25	4.63	4.56	2.53	.40
7457	Chas. York & Co., Bangor	25	5.20	5.20	2.32	.33
	MALT VINEGARS.					
7392	H. J. Heinz Co., Pittsburg, Pa. Olfene & Holmes, Auburn	25	5.84	5.68	1.60	.17
7409	H. J. Heinz Co., Pittsburg, Pa. Geo. C. Shaw Co., Portland	30	7.77	7.32	2.28	.25

* When two names are given, the first is that of the manufacturer.

Description and results of analyses of samples of different kinds of vinegars collected in Maine in the fall of 1906.

Station number.	Manufacturer and dealer.*	Cost per gallon	Total acids.	Volatile acids.	Total solids.	Ash.
	MALT VINEGAR.	cts.	%	%	%	%
7454	H. J. Heinz Co., Pittsburg, Pa. J. H. Snow Co, Bangor.....	30	6.01	5.78	2.14	.28
	DISTILLED VINEGARS NOT COLORED.					
7446	Anderson & Edwards, Smithville, N. Y. Geo. Simpson, Skowhegan...	20	3.72	3.72	.14	.02
7398	Josiah Bowker, Lewiston. Manufacturer not known.....................	25	4.50	4.44	.13	.06
7421	Jos. Carrier, Biddeford. Manufacturer not known...........	25	5.28	5.26	.12	.02
7401	E. E. Clifford & Co., Portland. John LaCroix, Lewiston......	20	3.56	3.56	.13	.04
7415	E. E. Clifford & Co., Portland. Biddeford Grocery Co., Biddeford........	20	3.94	3.90	.13	.05
7399	C. H. Cloutier & Co., Lewiston. Manufacturer not known..................	25	5.41	5.38	.19	.0
7428	Haskell, Adams Co., Boston. Merrill Bros., Augusta......................	25	6.22	6.22	.19	.0
7393	H. J. Heinz Co., Pittsburg, Pa. C. M. Penney, Auburn......................	25	6.66	6.61	.13	.0
7418	H. J. Heinz Co., Pittsburg, Pa. Jos. Menard, Biddeford....................	25	6.42	6.42	.19	.0
7456	H. J. Heinz Co., Pittsburg, Pa. Fred T. Hall & Co., Bangor................	—	6.19	6.18	.25	.01
7458	H. J. Heinz Co , Pittsburg, Pa......... .... R. E. Hovey & Co., Bangor.................	30	6.68	6.66	.19	.05
7427	E. Locke, Augusta. Manufacturer not known..................	25	6.57	6.56	.31	.03
7416	S. C. Messier, Biddeford. Manufacturer not known....................	20	2.98	2.98	.15	.04
7423	Murphy Bros., Biddeford. Manufacturer not known..................	—	3.26	3.26	.16	.04
7402	Neally & Miller, Lewiston. Manufacturer not known....................	20	4.28	4.24	.15	.05
7441	Alex Quirion, Waterville. Manufacturer not known..................	25	6.24	6.22	.21	.04
7448	John Watson Co., Houlton. Chas. F. Wilson, Houlton..................	25	7.54	7.54	.23	.07

* When two names are given, the first is that of the manufacturer.

Description and results of analyses of samples of different kinds of vinegars collected in Maine in the fall of 1906.

Station number.	Manufacturer and dealer.*	Cost per gallon.	Total acids.	Volatile acids.	Total solids.	Ash.
	DISTILLED VINEGARS, COLORED.	cts.	%	%	%	%
7397	Josiah Bowker, Lewiston. Manufacturer not known	20	3.71	3.70	.55	.35
7403	E. E. Clifford & Co., Portland. Neally & Miller, Lewiston	20	4.01	3.98	.26	.07
7413	E. E. Clifford & Co., Portland. Foster Co., Portland	25	4.21	4.20	.18	.02
7431	E. E. Clifford & Co., Portland. Pomerleau & Haerd Co., Augusta	20	4.24	4.18	.22	.05
7400	C. H. Cloutier & Co., Lewiston. Manufacturer not known	25	5.66	5.66	.33	.06
7450	A. H. Fogg Co., Houlton. E. A. Gillin & Co., Houlton	25	4.97	4.96	.26	.08
7444	Fuller-Holway Co., Augusta. O. G. Pelletier, Waterville	25	5.02	5.02	.29	.07
7439	H. C. Haskell, Waterville. Manufacturer not known	25	5.16	5.16	.60	.27
7453	A. W. Joy, Bangor Manufacturer not known	25	4.20	4.20	.53	.14
7404	Merrill & Crowell, Lewiston. Manufacturer not known	—	4.12	4.12	.20	.02
7443	N. J. Morin, Waterville. Manufacturer not known	25	5.56	5.56	.42	.15
7442	Alex Quirion, Waterville†	20	1.42	1.20	.94	.27
7389	J. P. Vickery & Co., East Auburn. J. W. Peables, Auburn	25	5.46	5.40	.13	.03
7451	John Watson Co., Houlton. McGary Brothers, Houlton	25	4.88	4.88	.28	.01

* When two names are given, the first is that of the manufacturer.

† There was only a small amount of this vinegar; it was in a barrel labeled from Haskell & Adams Co., Boston. Apparently Mr. Quirion bought a syrup vinegar and after it was largely sold out, added hard cider to it. The goods were withdrawn from sale.

NEWSPAPER BULLETINS AND CIRCULARS PUBLISHED IN 1906.

CHAS. D. WOODS.

Whenever there is a matter of importance which we wish to bring promptly to the attention of the people of the State, we make as clear and concise a statement as possible in the style and type of a newspaper column and mail it as a "Special Newspaper Bulletin" to all the press on the Station exchange mailing list. These newspaper bulletins are quite generally printed by the papers, and the Station is under obligations to the press for this opportunity of specially and promptly being put in touch with the people.

The Station also prepares circulars of information which are used in sending to correspondents. During the year the Station has issued several newspaper bulletins on miscellaneous subjects, and has issued quite a number of circulars relative to insects. The subject matter of such of the newspaper bulletins and circulars as has not appeared in the regular bulletins of the Stations is here printed as a matter of permanent record.

POTATO SCAB.

Potato scab is more or less prevalent all over Maine. Because in some years it is more troublesome than in others, and because the disease itself is so little understood by practical growers, there is danger of its not being regarded with the importance that it deserves. For these reasons the Maine Agricultural Experiment Station has prepared the following statements:

The common idea that potato scab is produced by chip dirt, ashes or something of that kind is erroneous. It is a fungus disease and grows from spores, the same as any other fungus. Certain conditions favor its growth and such favorable conditions may be furnished by chip dirt, lime, ashes, etc. When

once introduced into land, no practical way has thus far been found of removing it. How long it will remain in the soil is unknown. It certainly may continue for many years even when no potatoes are grown upon the field.

There are many ways in which it is possible for soil to become affected. The germs may be introduced into the manure pile by feeding scabby potatoes to stock, or by putting them directly into the compost heap. The fungus may then propagate itself in the manure and if this is applied to the land, the disease may be widely disseminated. Alkaline soil favors the growth of the fungus and on this account neither ashes nor lime should ordinarily be used in connection with potato growing. As farm manures are slightly alkaline, they are best not used on potato land. The plowing under of a green crop tends by its fermentation to make the soil slightly acid. This condition is unfavorable to the growth of the fungus. There is a more or less common belief that salt is something of a preventive of potato scab, but exact experiments have failed to demonstrate this.

Probably the most common way in which scab fungus is disseminated is by the use of infected seed. It is therefore of the utmost importance to use clean seed. Where it is impracticable to procure clean seed, or in case of doubt, it should be treated with a fungicide. While such treatment will help scabby seed, it may not act as an entire preventive. It is therefore best not to use seed that is much affected.

Formaldehyde gas either in solution or in the dry gaseous state can be effectively used to clean suspected seed. Formaldehyde (formalin) is sold in a solution of about 40 per cent. strength and can be obtained at any drug store. A few bushels of seed are most conveniently treated as follows: Make up a solution of formalin of the desired bulk, using 16 ounces of formalin (40 per cent. solution of formaldehyde gas) to each 30 gallons of water. Soak the seed two hours in this solution and then spread out the tubers to dry. After drying, the potatoes should be cut and planted in the usual way, but care should be taken not to allow them to touch any box, bag or bin where scabby potatoes have been kept.

The Vermont Experiment Station is studying the treatment of potatoes by formaldehyde gas, and while they have not

Fig 24. June Beetle

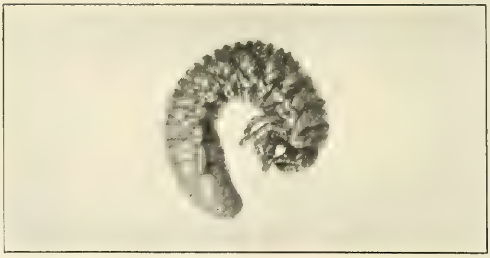

Fig. 25. White grub, larva of June Beetle

Fig. 26. Pelecinus polyturator parasite of white grub

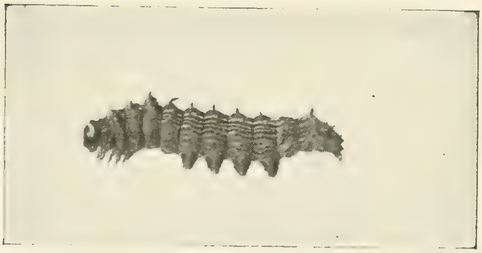

Fig. 27. Red-humped caterpillar

reached perfectly definite conclusions, they recommend the following treatment for potatoes in bins.

The bin or room where the potatoes are stored should be closed as tightly as possible. Ten ounces of formalin should be used for every 1,000 cubic feet of room, and the potatoes should be left exposed to this gas for 24 hours. The gas is generated by the action of formalin upon potassium permanganate. For this purpose 3 parts by weight of potassium permanganate are mixed with 8 parts of formalin in an earthen jar. The jar should have a capacity of about a gallon for each pint (16 ounces) formalin. The required amount of permanganate should be placed in the bottom of the jar, and the needed amount of formalin poured over it. The operator should leave the room at once, taking care to close the door as tightly as possible. The retail cost of the chemicals to produce gas for 1,000 cubic feet will be about $1.50.

For handlers of seed who wish to insure freedom from scab and for large growers of potatoes, this gaseous method is more convenient than the wet method, and experiments at the Vermont Station show it to be effective.

WHITE GRUBS AND JUNE BEETLES.*

The large brown June beetle commonly buzzing and bumping about lights at night, and the larva of this beetle (the white grub) so frequently turned up from the soil by the plow are both too well known to need description. The accompanying figures 24 and 25 illustrate both stages of this insect.

THE JUNE BEETLE. In the spring the fully developed beetles emerge from the ground where they have passed their larval stage. During the day they remain quiet but at night they congregate upon willow, cherry, plum and other trees to devour the leaves. These beetles deposit their eggs usually in grass lands.

*Seven or more closely related species, formerly classed as *Lachnosterna fusca*, are now called the *fusca* group. These with many other species are confused under the name of June beetle, May beetle, or Dorbug, and the larvæ of them all are sufficiently alike to permit them to be classed as one for economical treatment.

THE WHITE GRUB. From the eggs develop the white grubs which spent about 3 years feeding upon the roots of grass and other plants before they attain their full size. When grown they experience a period of rest in the pupal stage while the transformation to the adult beetle takes place.

Although grass roots are the native food of white grubs, a great variety of plants of agricultural value are liable to attack by them,—small grains, Indian corn, potatoes, and beets, to mention a few. Strawberries are especially susceptible and whole beds of these are sometimes destroyed if the plants are set in newly broken or poorly cultivated soil. Young corn meets the same fate if the grubs are thick in the soil. In meadow lands the grubs are often numerous enough to kill the grass over large spaces so that the loose sod can be rolled back like a carpet. It is in places like this that skunks wax fat and sleek, for they tear back the dead sod and eat great numbers of grubs with evident delight.

NATURAL ENEMIES. The white grubs are native insects and are not without natural enemies. Besides skunks which have just been mentioned, moles and ground squirrels eat them. Toads and frogs are fond of the beetles and probably insectivorous snakes deserve to be listed here. Great numbers of birds feed upon either the grubs or the beetles,—among them might be mentioned the robin, catbird, meadow lark, woodpecker, blackbird, crow, owls and hawks.

Fungus parasitism is not uncommon with these beetles and a few insect parasites, dipterous and hymenopterous, have been bred from the white grubs. One of these, the curious *Pelecinus polyturator,* recorded as parasitic upon the white grub by Dr. S. A. Forbes, State Entomologist of Illinois, is given in the accompanying illustration. This queer shaped parasite (Fig. 26) with slender crooked abdomen is common in Maine.

REMEDIES. As these insects pass most of their lives under ground. it is difficult to reach them with insecticides. Bisulphide of carbon, kerosene emulsion and poisoned baits have sometimes been used successfully over small plots but both the cost and the labor involved prohibit the use of the emulsion and bisulphide of carbon over large areas.

Fall plowing, thorough cultivation, and rotation of crops are practical measures. In general any management which

strengthens the plant will lessen losses from insect injury. A rich soil well cultivated may grow crops in spite of an infestation which would be fatal on poorly managed land. Mineral fertilizers such as nitrate of soda, are distasteful to many insects and have some value in this respect as well as in furnishing food for the plants.

Where chickens or turkeys can run through freshly cultivated soil infested by grubs, they prove efficient aids. *Swine are fond of the grubs and where they are pastured on infested land, they doubtless do more than any other means toward freeing the soil of the pests.*

It sometimes happens that the adult beetles are locally so numerous that it is possible and practical to kill them by spraying the trees where they congregate at night, with arsenical sprays. Sometimes, too, they can be jarred from the trees in great numbers and crushed or otherwise disposed of. The jarring is said to be especially effective from 2 to 5 o'clock in the morning when they seem to cling less tightly to the leaves.

Complaints concerning these white grubs have often been sent to this Station during the past 15 years. A report from Bridgton, Me., Sept. 18, 1893, reads in part: "There are many acres of grass land in this town where a good crop of timothy was cut the present season which now show hardly a green blade of grass. These worms (white grubs) are found just below the surface, where they feed upon the roots of timothy."

From Harrison, Me., June 5, 1906, a correspondent writes: "I broke up two acres for sweet corn where the grubs have eaten the grass so it plows like old ground."

These complaints, 13 years apart, are from neighboring towns and yet the correspondent from Harrison says: "I was never troubled with them before."

The grubs become mature in three years and the beetles are not so likely to deposit eggs in places where the infestation has destroyed much of the vegetation as in fresher and more inviting fields.

In conclusion it may be said that though locally and temporarily the white grub is sometimes exceedingly troublesome, there are no indications that in this State they are likely to increase indefinitely or cause excessive damage to any one field for many consecutive years.

RED-HUMPED CATERPILLAR. ŒDEMASIA CONCINNA.

During August, September and October, the red-humped caterpillar is one of the most troublesome orchard caterpillars in the State. During 1905 more than 80 lots of these caterpillars were sent to the Maine Experiment Station for identification. Many correspondents reported that entire orchards of young trees were stripped of their foliage, except for the mid ribs of the leaves, before the presence of the pest had been discovered.

Life History and Description. The mature insect is an inconspicuous brown moth with wing expanse of slightly more than one inch. The female deposits eggs on the under side of a leaf in a cluster, usually during July. The young caterpillars, which soon hatch from these eggs, feed upon the tender tissues of the under side of the leaf, not attacking at first the upper surface. When they become larger they devour the whole leaf except the mid rib. They move in flocks, an entire brood feeding together and remaining in a cluster when resting. In the caterpillar or larval stage (Fig. 27) this insect is readily recognized. The body of the caterpillar is marked with fine longitudinal stripes of black, white and yellow, and short black spines occur in rows. The head is bright red and the first segment of the abdomen, which is conspicuously humped, is of the same color. The caterpillar in the early stages is not so distinctively marked, however, as the body of the young caterpillar is a dull amber and the head black, the striped markings and the red head not appearing until a later molt. The caterpillars reach their full growth (about 1¼ inches) from August to late October. When full grown, they descend to the ground and hide under leaves or other rubbish and make a glassy transparent cocoon, within which they pass their pupal period. They remain in the cocoon all winter and emerge the following season as mature moths.

Remedies. The red-humped caterpillars are not especially difficult to combat if a watch is kept for the colonies while they

are young. As they are gregarious, it is a simple matter to clip off the small twig containing the whole brood of little caterpillars. When they are larger they can often be dislodged by jarring the branch and destroyed on the ground. Arsenical sprays will kill them, but the presence of fruit makes this remedy undesirable for bearing trees late in the season.

THE YELLOW-EDGE OR MOURNING-CLOAK BUTTERFLY.

From Caribou to Kittery the elms in the State are visited by a species of spiny caterpillar which is often present to such an extent as to become a public nuisance.

Description and Habits. The adult insect (Fig. 30) is a large butterfly with wings of a rich purplish brown bordered on the upper side by a broad margin of buff. A submarginal band of black is decorated with a row of blue spots. On the under side the wings have a rough brown appearance which renders the butterfly almost impossible of detection when it alights upon the bark of a tree, its favorite resting place. This butterfly thus affords an excellent example of protective coloration. It is called in America the "yellow-edge" butterfly, or almost as commonly by its English name of "mourning-cloak."

Unlike many butterflies, the yellow-edge hibernates over winter in the adult stage and we see this species early in the spring or even in thaw spells during the winter flying about wooded places, or sipping moisture from wet moss and shallow pools. As soon as the leaves start in the spring, the butterfly deposits eggs for the first brood of caterpillars. There are two broods a season and the larvæ or caterpillars are found in Maine from June to late September. They occur most frequently in this State upon the elm, but they also feed upon willow, poplar, and occasionally, though not often, upon apple trees.

The caterpillars (Fig. 28) are formidable looking creatures covered with stiff, sharp spines, the larger of which are branched. The general color is black, flecked with small white dots. The black line which runs along the back is interrupted by eight spots of brick red.

The caterpillars are gregarious and feeding as they do, the whole brood on a branch together, they strip off the leaves thoroughly as they go. Unlike many caterpillars, they do not eat their molted skins and these are frequently seen clinging to a naked branch long after the caterpillars themselves have disappeared.

When full grown, the caterpillars usually migrate from the tree on which they fed to some neighboring shelter. They suspend themselves from the eaves of buildings, edges of clapboards, fence-rails or similar places and there molt for the last time the spiny skin.

The insect now appears in the form of a peculiar ash gray or brownish chrysalis which is sure to excite curiosity the first time it is met with. The shape is much more easily represented by a figure than by a description. When disturbed the chrysalis wriggles violently. Fig. 29.

In about two weeks (usually less with this species), the skin of the chrysalis cracks open and the adult butterfly emerges. The butterflies of the first brood deposit eggs for the next generation at once, but those of the fall brood hibernate in the adult stage and deposit eggs in the spring.

Natural Enemies. A disease sometimes attacks this insect in the larval stage and a whole brood of limp caterpillars will be found hanging dead to the branch where they had been feeding. A Tachina fly is commonly parasitic upon the caterpillar, the full grown maggots dropping from the caterpillars to the ground to pupate, about the time the caterpillars are suspending themselves in preparation for the chrysalis stage. Caterpillars thus attacked, however, die before the chrysalis is formed. A minute hymenopterous parasite deposits eggs in the chrysalis, as many as 89 developing in a single chrysalis.

Remedies. In localities where this insect is troublesome, it is well to be on the watch for the caterpillars and remove them while they are yet young. As they are gregarious, the whole brood can be removed easily by clipping the branch on which they are found. Removing the caterpillars by hand is the only remedy needed for small trees and will be sufficient for larger trees in towns supplied with apparatus for removing the winter nests of the brown-tail moths. Where a treatment by poison is desired, arsenical sprays should be thoroughly applied.

Fig. 28 and **Fig.** 29. Caterpillar and chrysalis of yellow-edge butterfly

Fig. 30 Yellow-edge butterfly

Fig. 31. Elm leaf curl caused by plant lice. Schizoneura americana

ELM LEAF-CURL.

A common and widespread enemy to the elm is the plant louse, *Schizoneura americana,* that causes the leaves to curl and present an unsightly appearance. Fig. 31.

The deformed leaf serves as a protection to large colonies of the plant lice, small insects covered with white powder; and contains, besides, the molted skins of the insects and a considerable amount of liquid. The liquid, which is excreted by the plant lice, is called honey dew because it is sweet, and is much sought after by ants who prize it highly as food.

The eggs of this insect live over winter in the crevices of the bark. As soon as the young plant louse hatches in the spring, it crawls out to a tender leaf and settles upon the under side. Here it inserts its beak and sucks the sap for food and the punctured and irritated leaf swells and curls. The individuals of this first generation or stem-mothers are comparatively large and plump plant lice that never acquire wings. They give rise to innumerable progeny that drain the leaf of sap.

The leaves become in consquence badly curled and often those near the tip of the twigs are abnormally clustered into a sickly looking mass or rosette. About the time the leaves become yellowish and unsightly enough to attract attention, a generation of the plant lice is developed which acquire wings and fly from the curled leaves for fresh quarters.

NATURAL ENEMIES. Lady beetles, both in the larval and adult stage, feed greedily upon plant lice and often clear a whole tree of these pests. Striped black and yellowish syrphus flies are commonly seen hovering near to deposit eggs and the maggots which hatch from these are exceedingly rapacious, devouring plant louse after plant louse in quick succession. Predaceous bugs, (*Camptobrochis grandis* and others) are also frequently found feeding upon this species of plant louse.

Besides these predaceous insects, minute internal parasites develop in the bodies of the plant lice, thus destroying great numbers of them.

The ants which attend colonies of plant lice so industriously do not injure them in any way, but are there merely to gather the honey dew.

REMEDIES. Where shade elms are thus affected year after year, watch may be kept for the first signs of deformed leaves early in the season. If these are removed and burned the later numerous generations will not have a chance to develop. As the stem-mothers usually choose a terminal twig on which to start a colony, it is not a difficult matter to keep a young tree comparatively free from leaf-curl. Before the leaves become much curled, kerosene emulsion is an efficient remedy for frequent sprayings early in the season.

As a rule the trouble involved makes either of these measures impracticable when applied to very large trees. There is then nothing to be done except to endure the leaf-curl and leave the plant lice to their natural enemies, who find in the task of extermination both enjoyment and a means of sustenance.

The species of plant louse found in elm leaf-curl does not attack other trees and thus need not be feared as a general pest. Many other species of plant lice, however, have similar habits, as the ordinary plum aphis, or the snowball aphis, both common in this State. Where any valuable trees and shrubs are attacked year after year by leaf-curling plant lice, the clipping and destruction of the first deformed leaves and early spraying with kerosene emulsion are usually the only available remedies and are often perfectly practical.

Fig. 32 and Fig. 33. Yellow-necked caterpillar and pupa

Fig. 34. Datana ministra, adult of yellow-necked caterpillar

Fig. 35. Cecropia caterpillar

YELLOW-NECKED CATERPILLAR. *Datana ministra.*

During the late summer the yellow-necked caterpillar is a common orchard pest in Maine.

Life History and Description. The moth is tannish brown in color with head and the part of the thorax nearest the head a rich chestnut brown. Several dark brown lines cross the fore wings transversely. The hind wings are pale buff. The female moth deposits about 100 eggs in a cluster on a leaf.

The caterpillars which hatch from these eggs, attain their full growth in five or six weeks. They are then about two inches long. The head is black and the segment just back of the head is orange colored, a character which gives rise to the popular name "yellow-neck." The body is striped longitudinally with alternate yellow and black lines. Soft white hairs occur over the whole body but are too thin to be especially noticeable. Like the red-humped caterpillar, these caterpillars are clustered together both while feeding and when at rest. The caterpillars when at rest assume a characteristic and peculiar position on the branch with both extremities of the body raised. When alarmed they jerk their heads and tails in an irritated manner.

The full grown caterpillars bury themselves in the earth a few inches below the surface, where they transform into brown pupæ, unprotected by any cocoon. They remain in the earth all winter and emerge about the middle of the next summer, when they are transformed to the moth, or mature insect. Moth, larva, and pupa are figured in the accompanying illustrations, Figs. 32, 33, and 34.

Remedies. As in the case of the red-humped caterpillar, gathering the caterpillars by hand is the simplest remedy and perhaps the only one which it is necessary to recommend. The caterpillars are gregarious and the whole brood is easily removed from the tree and destroyed. Arsenical sprays will kill them, and may sometimes be a convenient means of combating them.

THE CECROPIA MOTH.

The large gray or brown cocoon of the Cecropia moth is frequently found attached to the twigs of trees. Fig. 36.

These are spun late in August or September by a green caterpillar about four inches long. The body of the caterpillar is ornate with colored bead-like tubercles, the two pairs nearest the head being red with black spines, and the other dorsal tubercles smaller and yellow. Along the sides of the body the tubercles are bluish. Fig. 35.

After the cocoon is spun the caterpillar changes to the pupa, a dark brown object which may be found by opening one of the cocoons during the winter. Fig. 37.

In the spring the insect breaks open the brown pupal skin and emerges from the cocoon as the adult insect, the largest moth in the State and one of the most beautiful. Its expanded wings measure about five and one-half inches. In color the wings are brownish with a border of gray and submarginal lines of white and red. The form of the markings is better represented by the accompanying illustration (Fig. 38) than by a description.

The caterpillar is well attended by insect parasites and is devoured by birds. In this State it has not occurred to a troublesome extent and need not be feared as a pest, although it feeds on apple and various forest trees. No remedies usually seem necessary. If the caterpillars are found upon a small tree which they are likely to injure, hand picking will prove effectual.

Those who find the Cecropia cocoons during the winter are often interested to save them in a warm room for the sake of observing the beautiful moth which emerges.

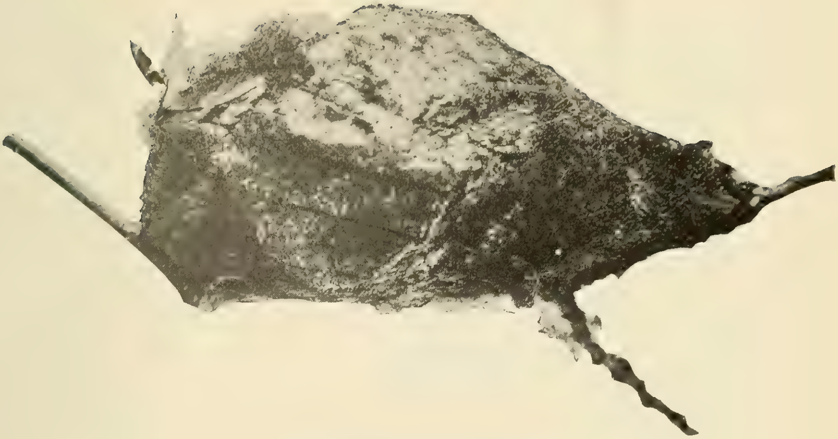

Fig. 36. Cecropia cocoon

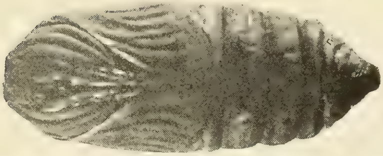

Fig. 37. Cecropia pupa removed from cocoon

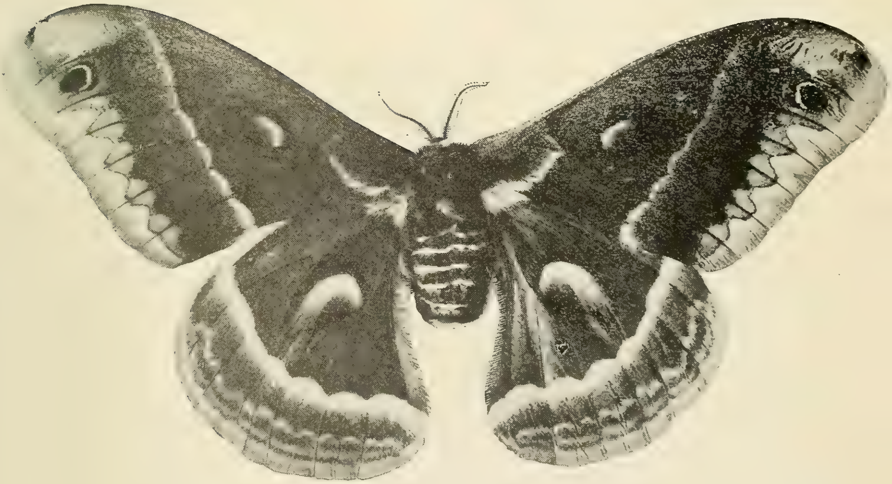

Fig. 38. Cecropia moth

TENT CATERPILLAR.

Encircling the twig of apple, plum, and wild cherry trees is frequently found a glistening brown mass about three-fourths of an inch in length. Fig. 39.

From such an egg cluster hatch in the spring from 200 to 300 caterpillars, which live in a colony and construct a whitish tent-like web in the angle of two convenient branches. It is in the habit of the tent caterpillars to pass their time when not feeding, particularly at night and during cold or stormy weather, within the tent which they enlarge as their own rapid increase in size calls for more room. During the warm sunny hours of the day they leave their protection and feed voraciously, defoliating the branches in the vicinity of the tents. One colony is enough to denude a young tree or several large branches of an old tree.

The tent which is at first a delicate filmy silken web becomes by the time the caterpillars are full grown a structure two feet or more in length, unsightly with the accumulation of molted skins and other rubbish. Fig. 40.

The full grown caterpillar is nearly two inches long. It is slender, dark, and velvety with numerous soft golden brown hairs upon the body. A white stripe marks the middle of the back, while the sides are streaked irregularly with white or yellow. Along each side of the dorsal white line is a row of transverse pale blue spots.

After feeding for four or five weeks the caterpillars leave the tree in search of a sheltered place for their cocoons, a crevice in the bark, the eaves of buildings, or rubbish piles, proving attractive for this purpose. The cocoon is an elongated oval with the outer silk delicate and loosely woven and the inner part firmer and close. The inner cell is painted on the inside with a thick yellow liquid which soaks through the cocoon and soon dries to a yellow powder. Fig. 41.

The insect remains in the cocoon from two to three weeks, when it emerges as a brown moth expanding about one and one-half inches. The fore wings are crossed obliquely by

two pale lines. The general color of the moth varies from buff to reddish brown in different individuals. Fig. 42.

Natural Enemies. The tent caterpillar is supplied with natural enemies among the birds and parasitic insects. It is susceptible also to attack by bacterial and fungus disease.

Remedies. This insect is so easy to combat that its presence to any great extent in an orchard is due largely to negligence. During the bright days of winter and spring the egg masses are readily detected on young twigs as their varnished surfaces glisten in the sun. These should be removed and burned.

Since the caterpillars congregate in their tents at night and are not early risers, they can be destroyed, the whole colony at once, by soaking the tent with kerosene emulsion, or soap or washing powder suds. This may be applied by a swab attached to a pole. Any time when the whole family is "at home" is suitable for this remedy, as the early morning, evening, or a cold or cloudy day.

Arsenical sprays will kill the caterpillars and may be applied to the branches near the tents. Trees sprayed early in the spring for the bud moth and other early caterpillars will be sufficiently protected against the tent caterpillar also.

TUSSOCK MOTHS.

Among the most constantly appearing orchard pests in the State are the white-marked tussock moth and the antique tussock moth, *Notolophus leucostigma* and *Notolophus antiqua.*

Description and Habits. The conspicuous white egg masses of these moths are deposited late in the summer or in the fall upon the cocoons from which the female moths emerge. As the hairy cocoons are commonly attached to the rough bark, or twigs of the trees the caterpillars infest, the egg-masses are readily found at any time after the leaves have fallen. The eggs which the white-marked tussock deposits are covered with a white frothy substance which becomes brittle upon exposure to the air. Fig. 43. The antique tussock does not protect its eggs in this manner but leaves them uncovered upon the cocoon. Fig. 46.

Fig. 39. Egg-mass of tent caterpillar

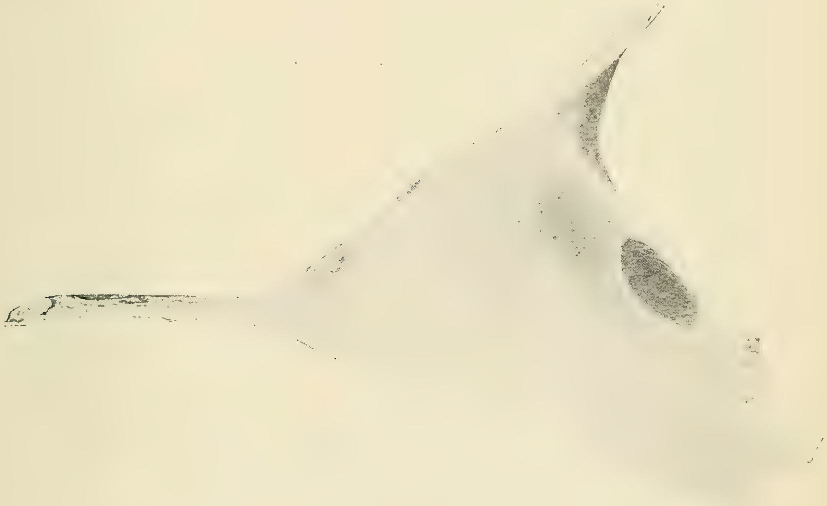

Fig. 40. Tent of tent caterpillar

Fig. 41 and Fig. 42. Cocoon and moth of tent caterpillar

The caterpillars which emerge from these eggs in the spring are most grotesque in appearance. The caterpillar of the white-marked tussock moth when full grown has a shiny coral red head beyond which extend two stiff pencils of black hairs directed forward like horns. A single pencil of similar construction supplies the other end of the body with a tail. Upon the middle of the back, starting a little behind the head, is a row of four regular tufts of soft whitish hairs which resemble small paint brushes neatly trimmed off at the tip. In a line with these but nearer the tail occur two little bright red tubercles. The full grown antique tussock caterpillar resembles closely the species just described. Its head, however, is jet black and it has an additional pair of black pencils, similar to though shorter than the horns, projecting from the sides of the body, which is lacking in the caterpillar of the white-marked tussock. These fantastic little creatures in masquerade attire hold a summer festival upon orchard and shade trees, which often proves to be a serious matter to the owners of the trees.

After feeding for four or five weeks the caterpillar becomes full grown and spins a rough cocoon of silk with which it mixes the hairs that have decorated its body. These cocoons are usually formed upon the bark or in the angles of twigs. Often a leaf is attached to the mass.

In about two weeks the adult insects emerge from the cocoons. Figs. 44 and 45. The males are winged, the white-marked tussock having gray wings which expand nearly one and one-half inches and the antique tussock having smaller brown wings. The female moths of these two species are not readily distinguishable. They never acquire wings and their distended bodies are practically little more than animated sacs of eggs. The females being unable to fly and their bodies being too heavy for their slender legs to drag about, cling to the cocoons from which they emerge and soon after mating deposit about 300 eggs in a mass upon the cocoon. This done they drop to the ground and die without feeding in the adult stage at all.

Natural Enemies. There are several species of parasites, a Tachina fly and an Ichneumon known as *Pimpla inquisitor* prominent among them in this State, which sometimes occur

in such numbers as to murder whole colonies of tussocks in their cocoons. These parasites are however in their turn well attended by parasites so that their aid cannot always be depended upon.

Remedial Measures. A glance over the life history of the tussock moths gives at once a simple and practical means of combating them. The white egg masses deposited on the cocoons remain on the trees all winter. These are readily seen and can be removed and burned. Cocoons of the tussock not covered with eggs should not be disturbed as they are either the empty cocoons of males or cocoons containing parasites. If the cocoons are empty they can do no harm and if they contain parasites, these insect enemies of the tussock should be allowed to develop.

Although the tussocks are two-brooded, this treatment is sufficient, for if the eggs of the winter generation are faithfully removed there will be no parents for the second or summer brood. The fact that the females cannot fly makes this pest easily controlled locally, for the orchardist need not especially fear his neighbor's infested trees.

The caterpillars are susceptible to arsenical sprays and this means of combatting them is sometimes necessary where the winter collecting has been neglected or when the tussocks appear in destructive numbers upon shade trees.

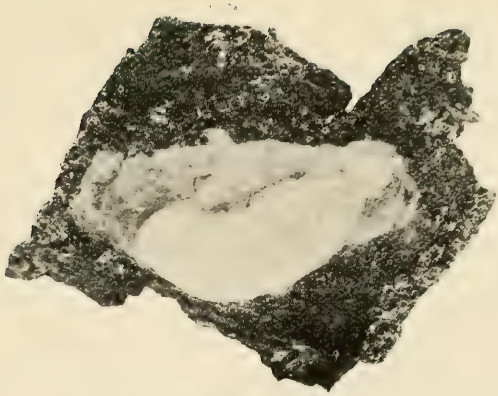

Fig. 43. Froth covered egg-mass of white marked tussock moth on bark

Fig. 44 and Fig. 45. White marked tussock moth. Winged male and wingless female

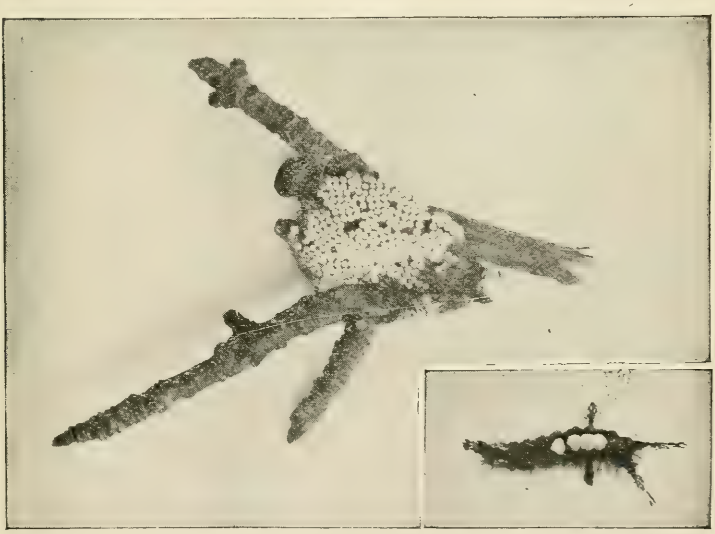

Fig. 46. Egg cluster and caterpillar of antique tussock moth

METEOROLOGICAL OBSERVATIONS.

Lat. 44° 54′ 2″ N. Lon. 68° 40′ 11″ W. Elevation 150 feet.

The instruments used at this Station are the same as those used in preceding years, and include: Wet and dry bulb thermometers; maximum and minimum thermometers; rain-gauge; self-recording anemometer, vane, and barometer. The observations at Orono now form an almost unbroken record of thirty-eight years.

In its meteorological aspects every year presents marked characteristics, and the year 1906 was no exception to this rule. The mean temperature for January was the highest ever recorded at this Station for this month, being nearly 10 degrees above the average for the past 38 years. The succeeding month was also warm, though less noticeably so. March, on the other hand, proved the coldest March since that of 1885, and with but three exceptions the coldest ever observed at this Station. The growing season, from June to September inclusive, was warm, and the killing frosts long delayed. These conditions were especially fortunate, since the heavy rains of May greatly delayed planting operations. The summer months were dry and the precipitation for the year was nearly five inches below the average.

METEOROLOGICAL SUMMARY FOR 1906.

Observations Made at the Maine Experiment Station.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	Total.
Highest barometer	30.65	30.83	30.66	30.40	30.23	30.05	30.30	30.28	30.34	30.45	30.17	30.51	30.41	......
Lowest barometer	28.98	29.28	29.65	29.05	29.38	29.39	29.47	29.52	29.20	29.07	29.37	29.21	29.25	......
Mean barometer	29.94	30.02	29.85	29.81	29.81	29.80	29.84	29.87	29.92	29.94	29.85	29.93	29.88	......
Highest temperature	52°.0	49°.0	50°.0	64°.0	83°.0	85°.0	87°.0	95°.0	82°.0	73°.0	56°.0	43°.0	....	......
Lowest temperature	-2°.0	-15°.0	-10°.0	14°.0	28°.0	34°.0	42°.0	39°.0	27°.0	23°.0	5°.0	-21°.0	....	......
Mean temperature	25°.7	21°.9	23°.4	40°.0	51°.4	63°.1	68°.6	69°.0	59°.2	48°.6	34°.1	17°.0	43°.50	......
Mean temperature for 38 years	16°.1	19°.0	28°.0	40°.7	52°.5	61°.8	67°.0	65°.0	57°.3	45°.0	34°.1	20°.3	42°.23	......
Total precipitation in inches	3.09	2.27	4.34	3.65	5.44	2.86	2.47	1.69	1.51	4.90	3.52	3.37	....	39.11
Mean precipitation for 38 years	4.26	3.84	4.35	2.88	3.54	3.51	3.27	3.50	3.35	3.85	3.72	3.77	....	43.84
No. of days with precip. of .01 in. or more	6	5	9	10	15	10	10	6	9	9	13	12	....	114
Snow fall in inches	6.2	12.5	21.8	11.5	....	....	....	....	....	0.5	20.5	24.7	....	97.7
Average snow fall for 38 years	22.6	21.2	16.0	5.3	0.3	....	....	....	....	0.8	8.3	17.3	....	91.8
Number of clear days	14	11	16	9	9	10	11	20	12	12	6	9	....	139
Number of fair days	5	5	1	5	7	8	9	5	9	5	6	7	....	72
Number of cloudy days	12	12	14	16	15	12	11	6	9	14	18	15	....	154
Total movement of wind in miles	5235	5154	6733	5261	5340	4540	3830	3623	4824	4443	6377	4656	......	......

Monthly and Annual Precipitation (as rain) for the Year 1906.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Bar Harbor	4.46	2.70	8.10	4.33	4.78	2.25	2.28	0.75	1.40	4.40	4.10	4.55	44.10
Chesuncook	2.39	1.61	4.94	......	......	......	......	0.91	......	......	......	......	......
Cornish	2.93	1.76	3.67	1.91	5.14	7.95	5.02	1.92	0.90	4.32	2.57	4.15	42.24
Debsconeag	......	2.20	......	......	3.53	2.38	3.25	3.16	2.89	7.43	2.87	......	......
Eastport	3.36	2.30	6.32	3.51	5.63	1.46	1.91	1.79	0.78	3.64	3.56	5.13	39.33
Fairfield	2.59	2.52	......	3.69	3.55	3.29	5.32	4.78	1.55	5.38	2.63	3.55	......
Farmington	2.29	1.89	4.30	2.06	3.67	5.41	6.38	2.42	0.65	4.84	2.94	3.17	40.02
Fort Fairfield	1.86	1.56	2.99	......	3.38	3.52	......	......	......	......	......	......	......
Gardiner	2.95	1.98	4.80	3.74	4.52	4.89	6.40	1.21	0.94	5.73	3.95	3.41	44.58
Houlton	2.70	2.10	3.20	3.20	2.00	1.40	2.55	1.50	1.20	......	1.20	......	......
Lewiston	3.15	1.59	4.51	2.93	4.21	7.42	5.44	0.80	0.85	4.97	3.26	3.94	43.07
Madison	4.04	2.99	4.83	4.27	5.12	5.72	4.58	2.02	1.09	......	3.02	5.21	49.03
Mayfield	2.69	2.01	5.24	2.70	3.90	4.61	4.66	4.13	2.23	5.54	3.61	3.38	44.61
Millinocket	3.09	3.45	6.29	3.69	3.57	......	3.24	......	3.16	7.10	4.21	3.35	46.01
North Bridgton	2.77	1.52	3.87	2.36	4.66	6.13	5.82	1.79	0.83	5.18	......	4.32	42.61
Oquossoc	2.03	2.04	2.14	2.17	5.67	3.75	4.57	1.33	......	4.08	1.43	1.90	......
Orono	3.09	2.27	4.34	3.65	5.44	2.86	2.47	1.69	1.51	4.90	3.52	3.37	39.11
Patten	1.52	3.80	5.90	2.40	......	1.84	5.26	1.57	1.52	10.10	1.88	2.73	......
Portland	2.87	2.00	4.95	3.53	4.79	7.18	4.32	1.73	0.58	2.75	3.04	4.80	42.54
Rumford Falls	2.01	1.68	2.79	1.69	......	5.07	6.83	3.47	1.01	4.79	2.68	3.39	......
Thomaston	4.74	0.90	5.07	3.64	5.82	......	......	......	......	......	......	......	......
Van Buren	1.40	1.45	......	1.60	1.90	4.50	2.50	6.00	3.50	6.30	......	3.80	......
Winslow	2.78	1.33	3.33	2.78	4.64	3.28	5.18	2.96	1.16	5.86	2.90	2.24	38.50

With the exception of readings from the Orono station, the above table is compiled from the monthly bulletins of the U. S. Weather Bureau.

REPORT OF THE TREASURER.

Maine Agricultural Experiment Station in account with the United States appropriation, 1905-6, Hatch Fund:

DR.

To receipts from the Treasurer of the United State as per appropriation for the fiscal year ending June 30, 1906, as per act of Congress approved March 2, 1887		$15,000 00

CR.

By salaries:		
(a) Director and administration officers	$3,948 28	
(b) Scientific staff	3,087 58	
(c) Assistants to scientific staff	475 54	
(d) Special and temporary services	193 40	
Total		$7,704 80
Labor:		
(a) Monthly employees	$931 42	
(b) Daily employees	554 13	
(d) Teams	75 92	
Total		1,561 47
Publications		242 67
Postage and stationery		337 77
Freight and express		236 64
Heat, light, water, and power		592 56
Chemical supplies		135 70
Seeds, plants and sundry supplies:		
(a) Agricultural	$16 49	
(b) Horticultural	72 32	
(d) Entomological	11 40	
(e) Miscellaneous	160 19	
(f) Photography	80 31	
Total		340 71
Fertilizers		142 85
Feeding stuffs		1,298 85
Library		744 73

Tools, implements and machinery		284 49
Furniture and fixtures		38 42
Scientific apparatus		510 80
Live stock		44 62
Contingent expenses		21 50
Traveling expenses		449 01
Building and repairs		312 41
Total		$15,000 00

Maine Agricultural Experiment Station in account with the United States appropriation, 1905-6, Adams Fund:

Dr.

To receipts from the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1906, as per act of Congress approved March 16, 1906		$5,000 00

Cr.

By salaries:		
(b) Scientific staff	1,412 50	
(c) Assistants to scientific staff	212 50	
Total		$1,625 00
Labor:		
(a) Monthly employees	$148 97	
(b) Daily employees	166 15	
(d) Teams	5 30	
Total		320 42
Freight and express		70 53
Heat, light, water, and power		73 95
Chemical supplies		145 75
Seeds, plants and sundry supplies:		
(a) Agricultural	$33 75	
(b) Horticultural	64 88	
(d) Entomological	55 93	
Total		154 56
Fertilizers		38 68
Feeding stuffs		217 14
Library		427 21
Tools, implements and machinery		775 27
Scientific apparatus		870 49
Live stock		31 00
Building and repairs		250 00
Total		$5,000 00

I, the undersigned, duly appointed Auditor of the Corporation, do hereby certify that I have examined the books of the Maine Agricultural Experiment Station for the fiscal year ending June 30, 1906, that I have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $20,000.00, and the corresponding disbursements, $20,000.00; for all of which proper vouchers are on file and have been examined by me and found correct.

And I further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, and March 16, 1906.

GEORGE E. FELLOWS, *Auditor.*

Maine Agricultural Experiment Station in account with "General Account" for the year ending June 30, 1906.

DR.

To balance from 1904-1905	$1,108 80	
Sales of produce, inspection fees, etc	8,407 36	$9,516 16

CR.

By salaries	$2,530 89	
Labor	28 55	
Seeds, plants and sundry supplies	18 47	
Feeding stuffs	538 68	
Library	563 72	
Live stock	4 00	
Traveling expenses	269 15	
Buildings	1,876 86	
Balance to 1906-1907 account	3,685 84	9,516 16

ISAIAH K. STETSON, *Treasurer.*

INDEX.